

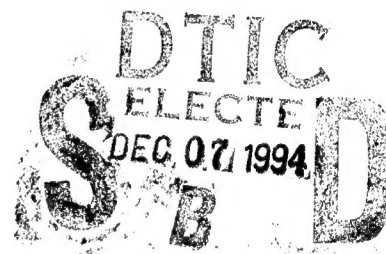
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**FUNDAMENTAL SKILLS TUTORING
PROJECT, DAYTON, OHIO AREA**



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Interim Report for Period August 1992 to July 1993

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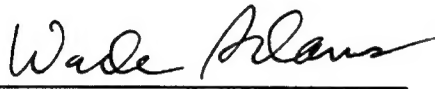
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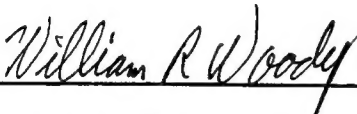
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SECTION 1: BACKGROUND

1.1 Armstrong Laboratory Connection

The Intelligent Training Branch of the Technical Training Research Division of Armstrong Laboratory at Brooks Air Force Base in San Antonio, Texas, has conducted studies in applying artificial intelligence to the goal of improving the skills of high school students. A product of the research project, called the Fundamental Skills Training (FST) Project, is the Intelligent Tutoring System or ITS. Three systems are being developed, the Word Problem Solving Tutor (WPS), a Reading and Writing Tutor (R-WISE), and a Life Science Tutor. These tutors are the results of a collaboration of teams of mathematics, English, and science teachers, computer programmers, educational psychologists, and management specialists. This report describes the Word Problem Solving (WPS) Tutor, its implementation in the Dayton, Ohio area through the efforts of Wright Laboratory at Wright-Patterson Air Force Base and some preliminary assessments.

The Tutors are programmed with a model of human thinking and learning using the principles of cognitive psychology. The ITS knows what to teach, how to teach, and who is being taught. The greatest advantage, therefore, is the ability of the Tutor to adapt to each student's needs. Rather than replacing teachers, the tutors will expand the ability of a teacher to provide individualized instruction and can provide important information to students and teachers to enhance classroom instruction.

1.2 Year One: Word Problem Solving (WPS) Tutor

Description of Tutor: The WPS Tutor is designed to teach ninth grade pre-algebra students word problem solving skills as well as more general problem solving strategies with broader applications. Four cognitive activities are employed in solving a problem and are represented as part of the WPS Tutor. In using the WPS Tutor, the student will:

1. Define the problem.
2. Represent the problem.
3. Solve the problem.
4. Reflect on the problem.

Local Component of National Program: Results from tests with high school students in the San Antonio, Texas area who used the WPS Tutor during the 1991-1992 school year were sufficiently promising to encourage the expansion of high school testing in other geographical areas. As a result, Armstrong Laboratory entered into an agreement with other Air Force laboratories, including Wright Laboratory at Wright-Patterson Air Force Base, Dayton, Ohio to test the WPS tutor in the Dayton area. Using a selection process described elsewhere in this report, two local high schools were selected, and arrangements were made for implementation of the program.

Dayton area school districts were selected for eligibility based on their designation by the Ohio Department of Education as "eligible for intervention" and/or their significant minority student populations. School districts received the intervention designation based on their performance on the Ohio Proficiency Test (fewer than 24% of the districts' students passed after two tries).

1.3 Role of the Alliance for Education

The Alliance for Education (formerly known as the Dayton-Montgomery County Public Education Fund or PEF) is a nonprofit organization which is a coalition of industry, education and government, acting as a third-party advocate to improve public schools. The Alliance for Education is independent of local school districts, but works closely with them. The Alliance for Education was awarded a grant by Wright Laboratory to administer and implement the local component of the project. (SEE Appendix "A" --May 4, 1992 letter from Wright Laboratory commander to PEF director inviting participation --and Appendix "B"-- technical proposal submitted by PEF to Wright Laboratory.) The grant was for one year with options for renewal for two additional years. The Alliance for Education developed the title "Project F.A.S.T. (Fundamental Academic Skills Training) Track" for reference to the local component of this national project.

Project Objectives: It was the responsibility of the Alliance for Education to organize and administer the local project to meet the following objectives:

1. To obtain research data on the effectiveness of the ITS of the Fundamental Skills Training program for Armstrong Laboratory by establishing regional testing sites.
2. To deliver individualized instruction through transferring the terminology of artificial intelligence applications in a pre-algebra word problem tutor to two public education systems in the Dayton area.
3. To develop student abilities to use mathematical concepts in solving specific word problems, interpreting tables, graphs, charts and diagrams, and communicating mathematics-related concepts.
4. To facilitate the development of the application of domain-independent problem-solving skills in solving mathematics problems.
5. To support school districts' efforts to increase student test scores on the Ohio Proficiency Test in mathematics.

Alliance for Education Responsibilities: The Alliance For Education's task was to coordinate all facets of the project including

- ◆ Administer all grant funds effectively.
- ◆ Assemble and facilitate a local project team to implement and oversee the project goals.
- ◆ Supply appropriate staff support for all phases of the project implementation.
- ◆ In cooperation with the project research team, develop site selection guidelines and procedures, as well as an application process, and communicate that information plus participant requirements to eligible school districts.
- ◆ Recruit and convene a broad-based committee of experts to advise on site selection, using specific criteria which included district test scores and/or significant minority populations, school district proximity, site proximity, willingness and commitment to provide local

support to the project, demographic mix, control population potential, and research requirements.

- ◆ Supervise the renovation of classrooms at both schools into state-of-the-art computer laboratories, each containing a network of thirty 386 processor-based computers.
- ◆ Help to ensure proper training for participating teachers and school site coordinators by conducting preliminary and follow-up sessions with teachers and school district personnel to supplement the four-day training the teachers received from Armstrong Laboratory personnel and by meeting regularly with teachers and school district personnel throughout the school year.
- ◆ Work with Armstrong Laboratory personnel to schedule and assist with proctoring pre- and post-tests required for research.
- ◆ Contract for a qualified computer technician to be in the computer laboratories with teachers and students at all times for immediate resolution of any hardware or software problems or questions.
- ◆ Serve as liaison for teachers, district administrators, and Air Force personnel at both Wright Laboratory and Armstrong Laboratory. Coordinate and facilitate periodic meetings with the above stakeholders to ensure adequate communication.
- ◆ Upon request, submit local status reports and recommendations to Wright Laboratory.

1.4 Timeline for Planning Period and Year One of Project Implementation (MAY 1992 - JULY 1993)

May 1992

- ◆ A project orientation session was conducted by Armstrong Laboratory personnel for representatives from the four eligible local school districts.
- ◆ All eligible districts submitted applications to the Alliance for Education to participate in the research project.

June 1992

- ◆ An advisory committee recruited by the Alliance for Education reviewed and rated applications and recommended that Dayton Dunbar and Trotwood-Madison High Schools be selected to participate. The four school districts were notified of site selection.
- ◆ Planning meetings were held with districts regarding renovations needed to convert classrooms to computer laboratories.
- ◆ Local project team members conducted an orientation session for participating Dunbar and Trotwood-Madison mathematics teachers and school site coordinators.

July 1992

- ◆ A grant to administer the project locally was formally awarded to the Alliance for Education.
- ◆ A grant to assist with classroom renovations was awarded to the Alliance for Education by the Engineering & Science Foundation of Dayton.
- ◆ Renovation of classrooms began.

August 1992

- ◆ Renovation of classrooms continued and needed equipment was ordered.
- ◆ NCR Corporation agreed to become a partner in the project, and NCR computers were ordered for the laboratories.

- ♦ Local teachers, school site coordinators, and the project's Wright Laboratory Point of Contact (POC) attended a four-day training session in San Antonio, Texas which was conducted by Armstrong Laboratory personnel for teachers from all participating research sites.
- ♦ A local debriefing session for the teachers was held following the San Antonio training.

September 1992

- ♦ Classroom renovations were completed, and computers were delivered and installed.
- ♦ Mathematics classes at Dayton's Belmont and Colonel White High Schools were selected to participate as non-treatment groups (pre- and post-testing with traditional classroom teaching).
- ♦ Teachers at Dunbar and Trotwood-Madison High Schools and local project team members began meeting together weekly for planning purposes and to discuss concerns.
- ♦ Laboratory schedules were developed.

October 1992

- ♦ Armstrong Laboratory personnel installed the Word Problem Solving software at both local high schools.
- ♦ Armstrong Laboratory personnel, assisted by local project team members, conducted pre-testing of Dunbar, Trotwood-Madison, Belmont and Colonel White High Schools.
- ♦ The Alliance for Education negotiated a contract to ensure that a computer technician was in the laboratories at all times throughout the year with teachers and students.

November 1992

- ♦ Teachers and students began working in both laboratories, with students visiting the laboratories an average of one day a week.
- ♦ Dunbar and Trotwood-Madison teachers received one-half of the stipends awarded to them in recognition of their participation in the project.

December 1992

- ♦ An interim meeting was held for Dayton and Trotwood-Madison district personnel and local team members to discuss progress and concerns and to ensure that the teachers were receiving adequate support.
- ♦ Local school site coordinators and two project team members traveled to San Antonio, Texas to attend a two-day meeting conducted by Armstrong Laboratory personnel for representatives from all research sites.
- ♦ Planning began for a February, 1993 formal dedication ceremony involving all stakeholders.

January 1993

- ♦ Armstrong Laboratory personnel, assisted by local project team members, conducted both post-testing for first semester and pre-testing for second semester at Dunbar, Trotwood-Madison, Belmont and Colonel White High Schools.
- ♦ Armstrong Laboratory personnel installed an upgrade of the WPS Tutor at both schools.

February 1993

- ♦ A formal dedication ceremony, held at NCR World Headquarters and at Dunbar and Trotwood-Madison High Schools, was conducted by personnel from Wright-Patterson Air Force Base, including Wright Laboratory; Armstrong Laboratory; Dayton and Trotwood-Madison school districts; NCR Corporation; the Engineering and Science Foundation; and the Alliance for Education.

March 1993

- ♦ Armstrong Laboratory personnel, local project team members, and Dayton and Trotwood-Madison district personnel, including administrators and English teachers, began planning for Year Two research involving ninth grade English classes using the Reading and Writing Tutor (R-WISE--Reading and Writing in a Supportive Environment).
- ♦ Armstrong Laboratory and local project team members met with participating Dunbar and Trotwood-Madison High School mathematics teachers to discuss progress and concerns.

April 1993

- ♦ Local school site coordinators and two project team members traveled to Albuquerque, New Mexico to attend a two-day meeting conducted by Armstrong Laboratory personnel for representatives from all research sites.

May 1993

- ♦ The local project team proposed to the Dayton School District that the Dunbar High School laboratory be made available during summer school to Dayton students who had not yet passed the mathematics portion of the Ohio Proficiency Test.
- ♦ Armstrong Laboratory personnel, assisted by local project team members, conducted post-testing of Dunbar, Trotwood-Madison, Belmont and Colonel White High School students.
- ♦ An end-of-the-year meeting was held for Dayton and Trotwood-Madison district personnel and local project team members to discuss progress and recommendations for Year Two of the project. Teachers and students also completed a locally developed attitude survey to assist the local project team in determining both the effectiveness of the tutor and the effectiveness of its implementation locally.
- ♦ Dunbar and Trotwood-Madison teachers received the second half of the stipends awarded to them in recognition of their participation in the project.

June 1993

- ♦ Dayton School District personnel determined that they would not use the WPS tutor in the Dunbar laboratory during summer school, 1993 due to the lack of response from students who had not yet passed the Ohio Proficiency Test.
- ♦ Planning for Year Two continued with the ordering of needed equipment. A local orientation session for Dunbar and Trotwood-Madison English teachers was also held.

July 1993

- ♦ Dunbar and Trotwood-Madison English teachers had access to both computer laboratories in preparation for their traveling to San Antonio in August for formal training in the use of the reading and writing tutor (R-WISE--Reading and Writing in a Supportive Environment) and for the in-school non-treatment group's use of WRITE (Writing and Reading in a Technological Environment).

SECTION 2: SITE SELECTION

2.1 Criteria Set by Armstrong Laboratory

Dayton area school districts were selected for eligibility based on their designation by the Ohio Department of Education as "eligible for intervention" and/or their significant minority student populations. School districts received the intervention designation based on their performance on the Ohio Proficiency Test (fewer than 24% of the district's students passed after two tries).

2.2 Application Process

Four eligible school districts in the Dayton area--Dayton Public Schools, Jefferson Township Public Schools, Northridge Public Schools and Trotwood-Madison Public Schools--were contacted regarding the project. Representatives, including district superintendents, curriculum personnel and representative teachers, from all four districts attended an orientation session organized by the Alliance for Education and conducted by Armstrong Laboratory personnel. In addition, Air Force and Alliance personnel visited each proposed classroom with district personnel.

2.3 Selection Committee and Process

Composition of Committee: The Alliance for Education convened an advisory committee to rate those districts which had applied for participation in the project. The committee consisted of two university mathematics educators, two mathematics teachers, a representative from the business community, and a school district administrator (not of one of the four districts applying) who was also a member of the Alliance for Education's board of directors.

Criteria for Selection: Before meeting together, each committee member rated the four applications using the following criteria:

- ◆ The school and district are clearly interested in participating in the project and committed to its success.
- ◆ The school and the district have the capacity and willingness to support the project's technical/research needs (environment, reporting, subjects/students, etc.)
- ◆ District demographics demonstrate logical selection as a project site (test scores, student population, opportunity to impact student achievement, etc.)
- ◆ It is reasonable to expect that an acceptable project control group can be found and recruited for this school to ensure a viable research design.
- ◆ The district and/or school brings strengths to the project's opportunity for success.
- ◆ The project will assist this particular school with its current and/or planned efforts for improving mathematics education.
- ◆ The school district will adequately ensure that project teachers will have sufficient time to work together with project and district personnel and will enthusiastically support teachers with their project involvement.

- ♦ The district's challenges/difficulties can be reasonably overcome to ensure expectation of project success, and the school and district are willing and able to overcome them, with the assistance of the project team.

Based on the composite of individual committee members' ratings and on their discussion together, the committee recommended that Dayton Dunbar and Trotwood-Madison High Schools be selected to participate in the project. (SEE Appendix "C" for Dayton and Trotwood-Madison School Districts' applications.)

SECTION 3: SITE PREPARATION

3.1 Requirements Set by Armstrong Laboratory

Successful implementation of this technology involves more than just buying the right computer hardware and installing the right computer software. It also requires a commitment of space, people and time. Armstrong Laboratory personnel suggested dedicating an individual full-time for approximately two months for procurement of computer equipment and peripheral items. This is essential for initial set-up and implementation.

Site Preparation Manual: Armstrong Laboratory initially supplied a site preparation manual containing a moderately detailed list of site requirements (SEE Appendix "D".) This list of site requirements was established in order to ensure that each of the participating schools would have a similar laboratory environment. This removed variables from the research design which may have involved such issues as inadequate ventilation, noisy laboratory settings, poor lighting and cramped space. Some of the equipment requirements resulted from hardware needed to support the software, but the majority of the site requirements were somewhat flexible, depending on the local situation.

Specific Requirements: In order to ensure data integrity, the various test sites were required to be environmentally independent and closely resemble other sites where project research was being done. It was considered essential that (1) there be no deviations from operating conditions among the sites which would result in significant differences in student performance due to the local conditions, (2) the measured differences in performance be relatable to a very limited number of factors, and (3) the broad-based experiment have very tight control of extraneous parameters in order to maintain its scientific statistical significance. This translated into the need for a learning-conducive atmosphere, requiring subdued lighting, quiet surroundings, and moderate temperatures and humidity. Each laboratory room where research was being conducted needed to have the same minimum level of environmental control, necessitating the procurement of floor covering, soundproofing, plus air temperature and humidity control.

Each of the local sites selected was required to have an available classroom room large enough to contain 30 student desks with hardware and associated furniture. Environmental control, security, instructional support, and aesthetics were required to comply with the standards set by Armstrong Laboratory.

Local Recommendations: In some instances the site preparation manual prepared by Armstrong Laboratory would have been more useful if it had been more detailed and included actual brand names and model numbers of equipment needed. This would have made initial selection of local equipment easier (e.g., when purchasing color-capable computer projection units) since the people responsible for purchasing the proper materials and supplies are not necessarily knowledgeable about those items. The Alliance for Education forwarded a list of recommendations to Armstrong Laboratory for possible revisions and additions to the site preparation manual following local site preparation. (SEE Appendix "E".)

3.2 Grant Awarded to Alliance for Education by the Engineering and Science Foundation of Dayton

Since Public Law prevents the Air Force from purchasing general purpose equipment, such as carpeting and air conditioning on a research contract, and the public school system and the Alliance for Education were unable to assume this cost, a grant was sought and received from the Engineering and Science Foundation of Dayton. (SEE Appendix "F" for copy of grant application.) A total of \$7,240 of the \$15,000 awarded was spent in accomplishing these requirements. The balance of the grant funds was returned to the Engineering and Science Foundation.

3.3 Local Renovation Process

Time Frame: The renovation process began in June with classroom selection and was completed in September when the last of the equipment was delivered.

Room Selection: A variety of classrooms were considered for renovation at Dunbar and Trotwood-Madison High Schools. Room selection was based primarily on the size of the room, the ability to provide air conditioning, the availability of a security system, adaptability to the electrical requirements of the computer hardware, room aesthetics, and cost for renovation. The most critical of these requirements was room size. A fairly large classroom is required to accommodate 30 computers and desks with adequate space for instructor mobility during class.

Room Renovation: In any particular installation, the renovations which are required to meet site requirements will depend on existing conditions, and that was the case in the renovations at Dunbar High and Trotwood-Madison High Schools. Factors which especially influenced the renovation processes included

- ♦ Throughout the process, the Dayton School District provided considerable support through their district's Buildings and Maintenance Department. Dayton personnel assisted in the design of computer stations (SEE Appendix "G-1" for computer station drawings) for both schools and, when asked, provided names of several different potential vendors and contractors.
- ♦ The classroom at Dunbar High School required considerably less renovation than did the room at Trotwood-Madison. It was also a larger room which helped when determining locations for equipment and computer stations.

Floor Plans: Room size was the key factor when determining floor plans. The teachers' workroom immediately adjacent and connecting to the Dunbar classroom was adapted for use by the technician and the participating teachers. (The Dayton District then installed one-way glass in the connecting door so that visitors could observe the students in the lab without disturbing them.) At Trotwood-Madison, a partition was erected in order to provide a working area for the technician and teachers. (SEE Appendices "G-2" and "G-3" for floor plans of the schools.)

Steps in Renovation Process: In general, the local renovations may be grouped under the following categories:

- ♦ Electrical--Power lines, outlets and lighting.
- ♦ Physical alterations--Wall preparation and painting, room partitions, built-in bookshelves
- ♦ Carpet--Remove old and install new carpet.
- ♦ Furniture--(Locally designed) Student and teacher workstations, chairs, file cabinets, bookshelves and file cabinet.
- ♦ Equipment--Computers, printers, computer projection unit, overhead projector, projection screen and cart, white board.
- ♦ Security system--New door locks with limited access to keys; motion, sound, window and door-open sensors.
- ♦ Miscellaneous--Hooks for coats, wall clock, window blinds, mouse pads.

The final room appearances were spacious and comfortable. (See Figure 1.)

Phones: One of the conditions stipulated by Armstrong Laboratory was that each lab contain a phone line. At Dunbar High, two phone lines which already ran to the workroom next to the computer lab were easily activated. At Trotwood-Madison High, no phone lines were available to the classroom. Therefore, a cellular phone was purchased to ensure adequate communication among the on-site technician, Armstrong Laboratory, and local project personnel.

SEE Appendix "H" for an actual breakdown of renovation costs at the two school sites. Appendix I contains an inventory list of equipment at Dunbar High School.

3.4 NCR Corporation Partnership

Specifications for needed computer hardware, including a minimum of 386 processor-based computers, were distributed to area computer hardware businesses, and three of those businesses responded with quotations.

NCR Corporation's proposal to equip each school with one NCR 486 processor-based server and 29 NCR 486 processor-based clients was accepted. NCR personnel entered into a partnership relationship with other local project stakeholders by offering their technical expertise and advice as the laboratories were established and in an ongoing manner.



Figure 1. Dunbar High School students in computer laboratory.

SECTION 4: LOCAL PROJECT TEAM

4.1 Role

The role of the local project team has been to aid the local schools and support Armstrong Laboratory in their research activities. The local project team has included individuals from Wright Laboratory, the Alliance for Education, The University of Dayton, Wright State University, and local industry.

When the position of the project's Wright Laboratory Point of Contact (POC) was vacated in early 1993, Alliance for Education staff assumed that role.

4.2 Names and Affiliations

TABLE 1
NAMES AND AFFILIATIONS OF LOCAL PROJECT TEAM MEMBERS

NAME	AFFILIATION	PROJECT RESPONSIBILITY
Dr. Wade Adams	Research Scientist, Wright Laboratory	Wright Laboratory Liaison
Lt. Nancy Baerwald	Manager of Education Initiatives, Wright Laboratory	Wright Laboratory Point of Contact (until February, 1993)
Ronald Budzik	Vice President for International & Government Affairs, Mead Corporation	Alliance for Education Board member
Sue Elling	Executive Director, Alliance for Education	Principal Investigator
Mary Karr	Director of Community Relations, NCR Corporation	Alliance for Education Board member
Dr. Phillip Messner	Associate Professor of Educational Leadership, Wright State University	Program Assessment
Sue Rinehart	Deputy Program Manager, Alliance for Education	Program Manager
Katie Thorp	Associate Research Engineer, University of Dayton Research Institute	Program Assessment

(SEE Appendix "J" for list of Year One teaching teams.)

SECTION 5: TEACHER TRAINING AND SUPPORT

5.1 Local Strategy to Ensure Adequate Support

- ◆ When the participating schools were announced, each building principal designated a site coordinator. Districts were reimbursed for the equivalent of one class period per day of each site coordinator's time in order to ensure adequate time for the site coordinators to perform their duties. Dunbar High School's site coordinator was a teacher and math department chair; Trotwood-Madison's was the school librarian. Their responsibilities included serving as liaison between teachers, principal and local and Armstrong Laboratory project team members, as well as helping ensure adequate support for the teachers. Together with Alliance for Education staff, they developed a regular laboratory schedule and monitored that schedule.
- ◆ In recognition of the additional responsibilities they assumed, stipends were paid to teachers (\$1,500) and site coordinators (\$3,000). They received one-half in November and one half in May.
- ◆ The Alliance for Education conducted a local orientation session for the Dunbar and Trotwood-Madison High School mathematics teachers involved in the project in June. At that time, the teachers were given background information about the project and a preliminary agenda for the training they would undergo in San Antonio in August.
- ◆ A follow-up debriefing session was conducted after the teachers returned from that training. At that time, three of the eight teachers expressed concern about their lack of computer expertise. Members of the local project team, site coordinators, and the more computer-literate teacher participants assumed responsibility for the further training of those teachers.

5.2 Local Support of Training by Armstrong Laboratory Personnel

- ◆ The Alliance for Education made all travel and lodging arrangements for the teachers and site coordinator and coordinated the trip with Wright Laboratory Point of Contact (POC) Lt. Nancy Baerwald.
- ◆ Lt. Baerwald, on temporary duty orders, accompanied the teachers and participated in the four-day training session conducted by Armstrong Laboratory personnel in order to ensure adequate follow-up support for them.
- ◆ The Alliance for Education arranged for the teachers to earn Continuing Education Units (CEU's) from the Ohio Department of Education for their participation in the training in San Antonio. (SEE Appendix "K" for copy of Prospectus submitted.)

5.3 Local Team Support for Lab Start-up

On the first day that each teacher went to the computer laboratories with his/her students, a local project team member was also in the laboratory to aid the teacher and to help ensure that the project needs were addressed. (See Figure 2.) An Air Force representative explained to the students about the Air Force's expectations of them regarding the equipment in the laboratory.

For the remainder of the class period, the project team member answered students' general questions as well as specific software questions about the tutor. The project team member also ensured that the software was operational when each new class arrived and documented the software difficulties which occurred during the day, as well as any "bugs" discovered in the software.

5.4 Academic Year Support

- ♦ School site coordinators and local project team representatives maintained regular contact through phone conversations and periodic meetings.
- ♦ Site coordinators met with teachers each week, and local project team members joined them at least every other week. At that time, teachers shared successes, frustrations and concerns and developed strategies for addressing them.
- ♦ A joint meeting was held in December at the Dunbar High School laboratory for teachers, site coordinators, and principals from both schools, district curriculum personnel, and local team members. Meeting notes were forwarded to Armstrong Laboratory, and feedback was included in end-of-the-year local assessment.
- ♦ Armstrong Laboratory personnel visited both schools during March to receive feedback personally from the teachers.
- ♦ A joint end-of-the-year wrap-up session was conducted at the Trotwood-Madison laboratory, once again for teachers, site coordinators, principals, district curriculum personnel and local team members. Meeting notes were forwarded to Armstrong Laboratory, and feedback was included in end-of-the-year local assessment. (See Appendix "S", pages S-22 through S-26.)

5.5 Armstrong Laboratory Quarterly POC Meetings

Armstrong Laboratory conducted two meetings for each research site's Air Force Point of Contact (POC) and school site coordinators. A representative from the Alliance for Education also attended both meetings. Local representatives reported they appreciated the opportunity to interact with their counterparts at the other research locations (Rome, New York; Albuquerque, New Mexico; Salisbury, Pennsylvania; and San Antonio, Texas). Local school site coordinators expressed their pleasure as they understood their part in a larger project.



Figure 2. Wright Laboratory Point of Contact, Lt. Nancy Baerwald, observes Dunbar High School student.

SECTION 6: TECHNICAL SUPPORT

6.1 Armstrong Laboratory Requirements

Armstrong Laboratory's initial site requirements included a laboratory technician who would be on site with the teachers to load and download files and run the local network. This person was required to be computer literate and to be able to communicate effectively with the site coordinator, teachers and students. Funding for the salary of such an individual was included in the initial grant to the Alliance for Education.

6.2 Placement and Role of Laboratory Technician

The filling of this position helped prevent to the greatest extent possible the loss of opportunity for the students to use the computers by resolving problems with hardware or software promptly.

Consequently, the Alliance for Education job description required the technician to be able to:

- ♦ Install, maintain, and troubleshoot personal computers, networks, peripheral devices, and associated software.
- ♦ Perform backups regularly, and periodically download designated files vital to the research project.

Other requirements included having an Associates technical degree and two years of experience, or alternatively four years of experience in installation, software maintenance, and repair of personal computers, networks, and associated peripheral devices. Specifically, extensive knowledge, skill, and experience to solve common personal computer problems, software inoperability, and common peripheral device failures was required. In addition, the technician needed experience with Windows 3.1 or later and MS-DOS 5.0 or later, and to be skilled with Novell Netware or an equivalent LAN software package to maintain both the hardware and software aspect of a PC LAN. (SEE Appendix "L" for position description for computer technician.)

In order to ensure adequate expertise and to allow for flexibility in scheduling since a full-time technician was not needed during the first year of research, the decision was made to contract for a technician's time. Accordingly, the Alliance for Education signed a contract with SelectTech Services Corporation to provide the services delineated above. (SEE Appendix "M" for copy of contract.) Since each class which was involved in the program attended the laboratory once a week, one technician was able to accommodate both schools.

In practice, the technician expanded his role by performing functions such as support and instruction for teachers and students who were unfamiliar with computers and their operations. (See Figure 3.)

A total of 550.5 hours was logged by the technician for the period of November, 1992 through May, 1993 for both schools combined.



Figure 3: Laboratory technician assists a teacher and a student on the operation of the computer in the Trotwood-Madison High School computer laboratory.

SECTION 7: PUBLIC RELATIONS

7.1 Dedication Ceremony

Planning Process: Representatives from Wright Laboratory, Wright Laboratory Protocol Officer, the Public Affairs Office at Wright-Patterson Air Force Base, and the Alliance for Education planned a formal dedication ceremony which was held on February 19, 1993. The date for the ceremony was determined by the availability of the Commander of Aeronautical Systems Center, Lt. General Thomas Ferguson, who gave a short address.

Together the planning group identified and resolved various issues:

- ♦ Military protocol was considered in resolving all issues.
- ♦ Determining an invitation list involved input from all planners. Invitations were then mailed by the Wright Laboratory Protocol Office.
- ♦ Selecting a site for the ceremony was important in order to ensure that neither school district felt slighted and to endeavor to provide publicity for all of the stakeholders--both Dayton and Trotwood-Madison School Districts, Wright Laboratory, NCR Corporation and the Alliance for Education. Trying to ensure that both school districts were treated equally was important to everyone.
- ♦ Determining the format for the program was equally important for the same reasons.
- ♦ Since there was not time for everyone to visit both schools, Wright Laboratory personnel took photos of the labs which were displayed at the dedication ceremony.
- ♦ A video which included interviews of the two school site coordinators, the teachers and some students was also developed and available for viewing for those who attended the dedication but were unable to visit a school.
- ♦ In order to help explain the project, the group developed a brochure, using the one developed by Armstrong Laboratory as a model. (SEE Appendix "N".)
- ♦ A plaque, illustrating the cooperative effort among all of the parties involved in the research project, was designed by Wright Laboratory personnel and presented to each school district at the dedication.

Implementation: The dedication ceremony was hosted by the NCR Corporation at their World Headquarters Building. Representatives from Wright and Armstrong Laboratories; both of the local school districts, including superintendents, school board members, building principals and teachers involved in the project; city officials; members of the Alliance for Education board of directors; and the Engineering and Science Foundation of Dayton attended. (SEE Appendix "O" for formal program distributed to those who attended and Appendix "P" for detailed agenda.)

Immediately following the formal ceremony at NCR, those who attended divided into two groups and boarded military buses to visit one of the schools. Informal programs were held at the schools, and the plaques were hung in the computer laboratories as symbols of the schools'

participation in the research project. Visitors were then invited to observe some students and teachers working with the WPS Tutor and to enjoy light refreshments. (See Figure 4.)

7.2 Other Publicity: Newspaper Articles

Additional newspaper articles about the project can be found in Appendix "Q."

7.3 End-of-year Thank You's

- ♦ Armstrong Laboratory provided certificates of appreciation for all students who participated in the year's research. The Alliance for Education personalized each certificate, and Armstrong Laboratory personnel presented a certificate to each student following the end-of-the-year post-testing. (SEE Appendix "R" for a copy of the certificate.)
- ♦ The Alliance for Education provided a pizza party for the participating mathematics teachers at Dayton's Belmont, Colonel White, and Dunbar, and Trotwood-Madison High Schools on their last day at school in June as a token of appreciation for their participation in the project.

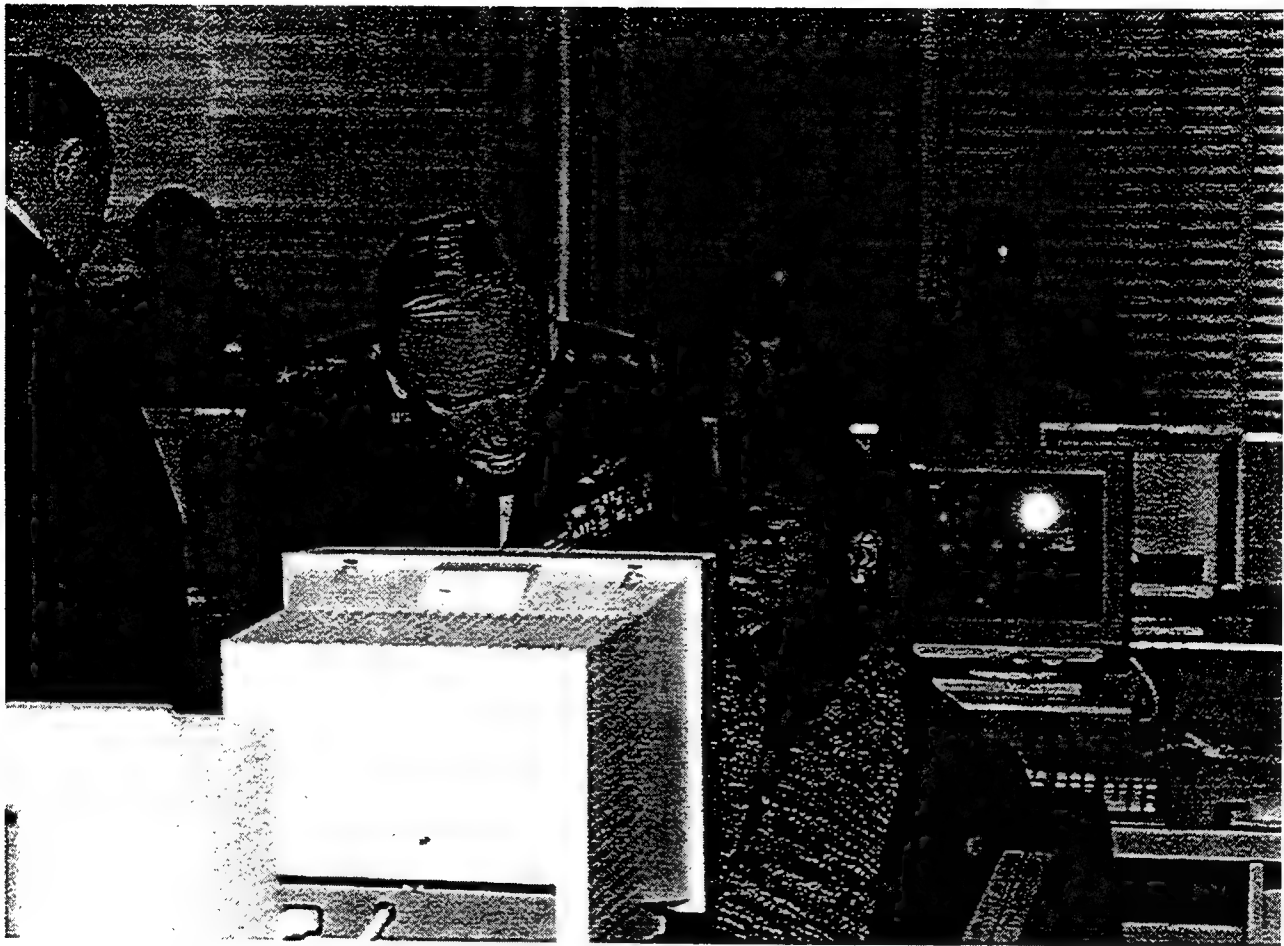


Figure 3. Lt. General Thomas R. Ferguson, Jr., Commander, Aeronautical Systems Center, and other Wright-Patterson AFB and community leaders visited the Trotwood-Madison High School computer laboratory immediately following the formal dedication ceremony on February 19, 1993.

SECTION 8: EVALUATION/LOCAL ASSESSMENT

8.1 Courses/Classes Involved

Dunbar and Trotwood-Madison High School students in nine Algebra I, Part I classes (a two-year Algebra I course) participated in the year-long research project. Four additional Pre-Algebra classes at Trotwood-Madison High School also participated in the project.

Below is a table listing the local schools, total number of local teachers and students, and the total number of local students completing all pre- and post-tests--and thus included in Armstrong Laboratory's data analysis.

TABLE 2
LOCAL HIGH SCHOOL TREATMENT & NON-TREATMENT GROUPS
INVOLVED IN YEAR ONE RESEARCH

GROUP	SCHOOL	TOTAL # TEACHERS	TOTAL # STUDENTS IN CLASSES 10/92	TOTAL # STUDENTS COMPLETING PRE & POST TESTS
Non-treatment	Dayton Belmont & Colonel White	4	243	61
Treatment	Dayton Dunbar	4	99	56
Treatment	Trotwood-Madison	3	200	125

8.2 Armstrong Laboratory Research Design

The majority of the research conducted in conjunction with this project was planned and administered by personnel from Armstrong Laboratory. Their initial research design included students at treatment and non-treatment sites. The non-treatment sites were given the same tests as the treatment sites, but students and teachers did not spend any time in computer laboratories with the tutor. Two local Dayton schools, Belmont and Colonel White High, participated in the study as non-treatment sites.

Students at all participating schools were given a standardized test (Otis-Lennen School Aptitude Test) in October, 1992. The following day the students were given a pre-test on solving word problems and an attitudinal survey. In January, 1993, all students were given a post-test for semester one and a pre-test for semester two. In May, 1993 students were given a post-test for semester two and an attitudinal survey.

The local project team assisted in administering each of these tests by facilitating scheduling and proctoring some of the testing. Results of these research activities will be published by Armstrong Laboratory personnel.

8.3 Local Observations/Assessment

A local assessment was performed to determine the local effect of the tutor and the effectiveness of the local team in implementing the program. In order to ensure that this assessment was performed in an orderly and effective manner, the assistance of educational assessment experts was obtained through a collaboration with Dr. Phillip Messner, Associate Professor of Education Leadership, and Dr. Carl Benner, Professor of Professional Services, at Wright State University.

The local assessment procedure involved noting comments and suggestions from teachers throughout the school year and administering attitudinal surveys to the teachers and students at the end of the school year.

The general results of this assessment procedure were positive. The majority of the teachers viewed the program as helpful and exciting for the students. A complete report of the local assessment is included in Appendix "S."

8.4 Accomplishment of Project Objectives

The Alliance for Education has organized and administered the local project to meet the following objectives:

1. To obtain research data on the effectiveness of the ITS of the Fundamental Skills Training program for Armstrong Laboratory by establishing a regional testing site.

As a result of a grant awarded to the Alliance for Education (formerly the Dayton-Montgomery County Public Education Fund) by Wright Laboratory, Dayton, Ohio became a regional testing site for the Fundamental Skills Training program. Beginning in October, 1992, data was collected by Armstrong Laboratory.

2. To deliver individualized instruction through transferring the terminology of artificial intelligence applications in a pre-algebra word problem tutor to two public education systems in the Dayton area.

Dayton Dunbar and Trotwood-Madison High School Algebra I and Pre-Algebra students utilized the Word Problem Solving Tutor from November, 1992 through May, 1993.

3. To develop student abilities to use mathematical concepts in solving specific word problems, interpreting tables, graphs, charts and diagrams, and communicating mathematics-related concepts.

Armstrong Laboratory will release data regarding the actual effectiveness of the tutor.

4. To facilitate the development of the application of domain-independent problem-solving skills in solving mathematics problems.

A regional test site has been established to support research conducted by Armstrong Laboratory. Armstrong Laboratory has collected data and will release that data regarding the actual effectiveness of the tutor.

5. To support participating school districts' efforts to increase school-site, student test scores on the Ohio Proficiency Test in mathematics.

Thusfar no comparison has been made between data collected by Armstrong Laboratory and participating students' test scores on the Ohio Proficiency Test in mathematics. SEE Section 9 for conclusions and recommendations of the local team.

SECTION 9: CONCLUSIONS, RECOMMENDATIONS, AND FUTURE

9.1 Conclusions and Recommendations

Through regular communication with project stakeholders and observation in the labs, Alliance for Education staff and local team members endeavored to ensure that the research design for this project was effective. As a result, the local team was able to assist Armstrong Laboratory personnel in making some "mid-stream adjustments."

Wright Laboratory and the Alliance for Education staff agree that preliminary Year One results are encouraging. However, the information from Armstrong Laboratory has been very general with little substantial support for the numbers. Therefore, the local team recommended that an additional year of research was needed to more fully evaluate the effectiveness of the software.

9.2 Next Steps

1. In response to that recommendation, Armstrong Laboratory agreed to gather data for a second complete year at both Dunbar and Trotwood-Madison High Schools, using the most current version of the Word Problem Solving Tutor, version 4.0. That version contains a complete curriculum, whereas the earlier versions did not. Thus, lab session activities will more directly correlate with classroom instruction. Also data will be collected from students using the advanced version for a complete academic year. This research will be conducted in addition to the current Year Two focus area of research which is on the Reading and Writing Tutor.

Algebra students at both Dayton Dunbar and Trotwood-Madison High Schools and students in Trotwood-Madison High's "Workshop" classes (for students in grades 10-12 who have not yet passed the Ohio Proficiency Test) will work in the school labs an average of one day a week. This will provide an opportunity to test the WPS tutor more fully and, hopefully, determine its usefulness as an Ohio Proficiency Test intervention strategy.

2. In response to a request from both Wright Laboratory and the Alliance for Education for additional information, Armstrong Laboratory personnel have also agreed to meet with local team members Phillip Messner and Katie Thorp to discuss Year One findings as well as Year Two research strategy and data collection.

SECTION 10: YEAR TWO IMPLEMENTATION OF R-WISE TUTOR

10.1 Upgraded Laboratories

In order to accommodate both the primary focus for Year Two research, which is on English classes using the Reading and Writing Tutor, R-WISE, and the second year of research on the Algebra and Pre-Algebra students using the WPS Tutor, computer equipment in both laboratories was upgraded. Additional hard disk drives were installed in the servers at both schools in order to accommodate both the WPS and R-WISE Tutors. Tape drives and additional printers were also purchased.

10.2 Teacher Training of Teachers

- ♦ A local orientation session was conducted in June to prepare the English teachers for the August training in San Antonio.
- ♦ Since the computer laboratories were available, the teachers and site coordinators met periodically throughout the month of July at the two labs to become familiar with the computers.
- ♦ Armstrong Laboratory personnel conducted a five-day training session for the treatment group teachers who would be using R-WISE and a two-and-one-half- day session for the non-treatment teachers who would be using WRITE (word processing only).
- ♦ Armstrong Laboratory personnel conducted an after-school training at one of the local computer laboratories for the mathematics teachers participating in Year Two of WPS Tutor research.

APPENDIX "A"



DEPARTMENT OF THE AIR FORCE

WRIGHT LABORATORY (AFSC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6523

REPLY TO
ATTN CC:

CC

SUBJECT:

Intelligent Tutor System.

TO:

Ms Sue Elling
Director, Dayton-Montgomery County
Public Education Fund
2100 Kettering Tower
Dayton OH 45423

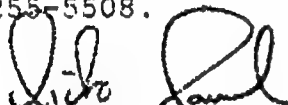
1. For the past two years, Armstrong Laboratory in San Antonio, Texas--another Air Force Laboratory like Wright Laboratory--has been conducting applied research into the application of artificial intelligence technologies to the basic literacy needs of America's public school students. This research project is called the Fundamental Skills Training (FST) research project. In support of FST, Armstrong Lab is developing intelligent tutoring systems (ITSs) in 9th grade mathematics, English, and science, and is testing these systems in public schools around the country. The preliminary test results achieved to date with the mathematics tutor (field tested in a San Antonio high school) are extremely promising. A fact sheet on the project is attached.

2. All of this is extremely exciting to us at Wright Laboratory. In fact, on May 1, 1992, we entered into a Memorandum of Understanding with Armstrong Laboratory to support continued research and development in the area of intelligent tutoring. One of the key components of this Memorandum is Wright Laboratory's commitment to support the opening of two high school test facilities for FST evaluation in the Dayton area. We'd like, with your help, to see these facilities opened in September of 1992, if at all possible. Accordingly, we would suggest that the role of your organization would be to identify appropriate schools to serve as test sites for this project.

3. If you're agreeable, the first steps to this project include learning more about Armstrong Laboratory's work in this area, identifying the schools which will participate in this project, and involving key teachers in the project as soon as possible. I have invited the project's manager, Major Jim Parlett, and several of his team members to Dayton to meet with us on 11-13 May. Major Parlett is specifically interested in identifying appropriate schools, meeting with potential participants from those schools, and touring their facilities during this visit.

4. Our initial discussions on this topic with Lt Gen Ferguson and the visiting Armstrong Laboratory team are scheduled for May 11, 9:00-10:00 am, in Building 14 at Wright Patterson AFB. On May 12 and 13, Armstrong Lab team members are available to discuss the program with representatives of the Dayton Public Schools, including teachers from potential test sites, as you deem appropriate. Dr Wade Adams of Wright Laboratory (255-2110) can provide you exact details on meeting times and locations for the May 12-13 sessions. He will be contacting you soon.

5. We look forward to your participation in this exciting project, and appreciate your consideration in serving as an agent to select high school test sites for intelligent tutoring. If you have any questions, please call me at 255-5508.



RICHARD R. PAUL
Colonel, USAF
Commander

1 Atch
FST Project Overview

APPENDIX "B"

TECHNICAL PROPOSAL

Dayton Area Fundamental Skills Tutoring Project

BACKGROUND

The Problem

Among President Bush's Education 2000 goals is for the United States to be first in the world in mathematics and science by the year 2000. This is an ambitious goal, at best. American students are clearly behind their peers in countries throughout the world. "In school mathematics, the United States is an underachieving nation...." (The International..., p. 5) International tests show that we have a very long way to go to reach the President's goal. However, if we do not reach it, our country's future is truly in jeopardy.

In April, 1991, the Commander's Policies of the Air Force Systems Command (AFSC) stated that as a leader in science and technology, "...the AFSC plays a vital role in supporting the goal of United States Technology Policy. 'The goal of U.S. Technology Policy is to make the best use of technology in achieving the national goals of improved quality of life for all Americans, continued economic growth, and national security.'" (Yates, U.S. Technology) The Air Force clearly can play a role in creating new methods and in assisting schools with the dramatic changes which must occur by transferring technology to them.

The scope of the problems is very broad and complex, and the solutions must be bold and must represent totally new approaches to bringing available resources to the schools. The challenges in improving mathematics education--critical to our future--rest on not only students learning basics but, perhaps even more importantly, on their learning to apply those basics through using problem solving skills--skills which schools rarely teach and with which teachers are ill-prepared to help students. "American public schools are in trouble. Student test scores have declined..., and public confidence in public education continues to falter.... Because of declining birthrates, there will be fewer new workers for entry level jobs.... The rapid developments in advanced technologies make it essential for workers to master basic skills and develop new competencies. The nation needs workers who are grounded in basic skills...and capable of rational problem solving." (Doyle)

The National Council of Teachers of Mathematics (N.C.T.M.) reports that their studies clearly show that society expects students to develop, "...the ability to set up problems with appropriate operations; [to develop a] knowledge of a variety of techniques to approach mathematical ideas to common and complex problems; the ability to see the applicability of mathematical ideas to common and complex problems; preparation for open problem situations, since most real problems are not well formulated...." (N.C.T.M., p. 10) And yet, study after study and even informal observations of nearly any mathematics classroom show that the vast majority of class time is spent emphasizing computational skills and the idea that there is one right answer and often even one "right" approach to getting that answer. "...although most students are reasonably proficient in computational skills, the majority do not understand many basic concepts and are unable to apply the skills they have learned in even simple problem-solving situations." (National, p. 11) This situation must be changed. "Reducing priority on development of routine skills will allow a variety of desirable consequences. There will be more time to develop understanding of processes and reasoning that lie at the heart of mathematical problem solving.... Indeed, enabling students to solve a variety of problems is one of the main purposes of school mathematics education." (Mathematical, pp. 19-20).

In addition to changing the way students are taught and the emphasis on computational skills, we must excite students about mathematics and help them to see that it is the key to the world of science and more. "Mathematics is the foundation of science and technology. Without strong mathematics, there can be no strong science." (National Research, pp. 61-62) And, the "pipeline" of students in mathematics, leading to careers in engineering and science, so essential for our nation's future and the future of our defense--must be filled. "More than any other subject, mathematics filters students out of programs leading to scientific and professional careers.... To function in Today's society, mathematical literacy...is as essential as verbal literacy.... Numeracy requires more than just familiarity with numbers. To cope confidently with the demands of today's society, one must be able to grasp the implications of many mathematical concepts.... Literacy is a moving target, increasing in level with the rising technological demands of society." (National Research, pp. 6-7) And, "Mathematics is the foundation of science and technology. Without strong mathematics, there can be no strong science." (National, Everybody, p. 35) Mathematics education is the most critical piece to the scientific and technology future of the United States, clearly including our national defense.

The Dayton Area Story

The Dayton area schools are no exception to the national picture. However, the local workforce needs for mathematical, scientific and technical literacy are significantly greater than many areas, in large part because of the enormous number of technology-based companies which support local industry and Wright-Patterson Air Force Base. Yet, "Dayton's public school system was designed to produce a labor force for a low-skilled manufacturing economy. It historically stressed vocational training over academic preparation for higher education and ... dropouts were expected and accepted because the labor market could generally absorb them whether they had a diploma or not.

"[The Dayton] area [has] shifted from a domestic manufacturing economy to one based on services and technology competing with an aggressive world market. There are new jobs being created...[which] require higher levels of skill [and] educational achievement." (Dayton's...pp. 4,6)

And, whether one uses student performance on national tests or on the Ohio Proficiency Test (passing this is now essential for graduation in Ohio), local scores are unacceptably low (SEE Appendix A). While the recent emphasis on the new N.C.T.M. Curriculum and Evaluation Standards and Professional Teaching Standards has begun to enlighten teachers, nearly all of them are struggling to learn how to teach differently. Teachers teach as they were taught. And, even those who understand that change must be made need new tools to help them with this enormous transition. The shift will be a difficult one.

THE OPPORTUNITY

Together with Armstrong Laboratory, Wright Laboratory has a timely and potentially dynamic opportunity to greatly impact schools--first in the Dayton area and, realistically, throughout the region. The expertise of the Air Force, particularly in artificial intelligence, can truly make the President's goal for mathematics, with particular emphasis on problem solving, (and, eventually, science) reachable. Even the experts in the mathematics community have not dreamed

of the possibilities with which the Air Force works effectively each day. "The eventual use of technology in the teaching and learning of mathematics can be seen, at best, only dimly today. Few classrooms today are equipped to make the use of computers convenient and inviting to teachers. Software.... Too often is neither teacher-friendly nor student-friendly...." (Mathematical, p. 21)

And, schools today are only beginning to see the importance of technology in reforming education. Even if educators do believe that technology is a key to this reform, they rarely understand what is available or how to use it. Isolated leaders in education are beginning to wave the banners of technology, but even these leaders have little support in implementing their ideas and almost none in learning about what is really available. In addition, the "real world" (outside the classroom) depends both on mathematical and computer literacy as tools for survival--let alone success. "Those who use mathematics in the workplace...rarely use paper-and-pencil procedures any more, certainly not for significant or complex analyses. Electronic spreadsheets, numerical analysis packages, symbolic computer systems, and sophisticated computer graphics have become the power tools of mathematics in industry. ...research mathematicians now use computers to aid exploration, conjecture, and proof." (National, Everybody, pp. 61-62) "Computing devices will...focus attention as much on problem formulation as on problem solving...[and] make possible tools for teaching and learning of a sophistication still largely undreamed of by most mathematics educators." (Mathematical, pp. 18-19) Air Force technology can move this process forward at an accelerated pace which otherwise would be impossible.

"How"

"[There is] general agreement that leadership in education and in the community is an essential first step toward school-community improvement.... We know that our schools and communities can be citadels of learning if they can generate public involvement and public ownership.... All of us...must become involved in efforts to improve our schools and, through them, our communities. We must create the political 'will' to improve education.... The community must be accepted as a full participating partner in education." (Center....) Wright Laboratory, working with Armstrong Laboratory and in partnership with area school districts, has an opportunity to bring about significant change in the Dayton area schools' mathematics programs and to positively impact student achievement...very quickly.

The Wright Laboratory has recently become part of a joint research project with the Armstrong Laboratory, the Fundamental Skills Training project, the primary purposes of which are to assist in the collection of valid research data in order to verify the educational and training effectiveness of the Intelligent Tutoring System (ITS) and to transfer the technology to public education and to industry. The four AF Laboratories (including Phillips and Rome Labs) signed a Memorandum of Understanding to that effect in April, 1992. In response to an increasing need for fundamental skills training and education in both the Air Force and public education, the Armstrong Lab (AL) has been conducting research for several years on artificial intelligence-based tutors, and since 1990 has been working with the San Antonio area public schools to develop the methods for application to public school education problems. The ITS developed by AL for remedial algebra was tested during the 1991-1992 school year, and is now ready for site-testing outside the San Antonio area. The second tutor being developed is a

writing tutor which will be tested in San Antonio in the 1992-1993 school year and will be ready for site testing in the 1993-1994 school year. The third tutor planned is a science tutor which will be ready for site testing in the 1994-1995 school year. This proposal is for year one--mathematics--with options for years two and three.

PROJECT OBJECTIVES

- 1) To obtain research data on the effectiveness of the Intelligent Tutoring System of the Fundamental Skills Training program for the Armstrong Laboratory by acting as a regional testing site.
- 2) To deliver individualized instruction through transferring the technology of artificial intelligence applications in a pre-algebra word problem tutor to two (2) public education systems in the Dayton area.
- 3) To develop student abilities to use mathematics concepts in solving specific word problems, interpreting and constructing tables, graphs, charts and diagrams, and communicating mathematics-related concepts.
- 4) To facilitate the development of the application of domain-independent problem-solving skills in solving mathematics problems.
- 5) To increase school-site, student test scores on the Ohio Proficiency Test in mathematics.

MATHEMATICS WORD PROBLEM TUTOR DESCRIPTION

System Overview

"Undoubtedly, the most effective way for people to learn to solve problems is to solve problems--lots of problems.... Before we can set out to practice solving problems, we must first learn how to recognize a problem. This is not an altogether trivial task." (Willoughby, p. 43) This project will provide students the opportunity to solve hundreds of problems and, more importantly, to work with "private" tutors to support their work. Since individual attention is effectively impossible in normal classes (and, due to ever-greater financial constraints on school districts, growing class sizes), Intelligent Tutoring Systems will play a critical role by providing that individual student direction and attention so essential to a realistic expectation of dramatic improvements in student achievement--by the year 2000 or at all! In addition, teachers will learn from the system not only what each student's strengths and weaknesses are (to guide their work with individuals and the lessons which they assign to each on the system) but also what the picture of their classes looks like. Therefore, teachers will have the opportunity to adjust classroom instruction on a daily basis to the needs of the classes and to the individuals in them.

The word problem tutor has a state-of-the-art ITS design (Polson & Richardson, 1988; Burns, Parlett & Luckhardt, 1991). Both mathematics and instructional expertise are incorporated into the tutoring system. Instructional decisions are based on a representation of the student and other instructional factors. The representation of the student is dynamically updated as the student solves problems.

Good problem solvers complete four cognitive activities between the time they discover that a problem exists and the time they finish thinking about what they learned in resolving the

- problem: gathering information, representing the information, implementing a solution and reflecting to derive knowledge that may be applied to similar situations in the future.

- Interface

There are several interfaces with separate functions that students can use to solve the pre-algebra word problems. Students use the interfaces to define the goal of the problem and the data given in the scenario, build tables using a spreadsheet, construct graphs, draw simple diagrams, make and solve equations and take notes about their problem solving using a word processor.

Defining the Problem

The problem solution interface includes tools for a student to analyze the word problem. A student must identify which sentence or question in the text represents the goal that the student is to achieve. A student must also identify and label each of the numbers relevant to solving the problems. Finally, for some problems, students must enter and label information which is not provided in the text of the problem. For instance, the number of days in a year is occasionally required for solution of the problem but not explicitly stated in the problem's text.

Representing the Problem

Currently, three interfaces allow the student to represent the information previously defined in a variety of ways. If the problem is best represented by a table, a student can construct the table of data using a simple spreadsheet. The student can create new columns of data by combining other columns using a formula. For some problems, students may want to develop a graph of the tabled data. Two dimensional graphs can be constructed and labeled using a second representational interface. A simple diagramming window is also included to represent visual-spatial information embedded within some types of problems. For instance, students can draw 2- and 3-dimensional diagrams for area and volume problems. A fourth interface, not yet developed will provide tools that will create visual presentations, such as histograms and pie charts.

Solving the Problem

The third major set of activities that a student must accomplish is actually solving the problem once a representation has completed. For some problems, making and solving an equation is crucial. In all problems, the students must explicitly answer the question. Computing a number with an equation is not sufficient to complete the problem. Rather, students must relate the derived number back to the goal statement defined earlier in the problem-solving activity. In some cases, problems must be answered with a Yes/No response instead of a number. If a number is required, a student must also include the units, such as miles per hour.

- Reflecting

One activity that is frequently not required of students, but that research is beginning to show is important, is reflecting back upon the activities in which s/he has been engaged. Recent research has shown that reflection results in greater initial learning and transfer of the skills to new contexts. In this tutoring environment, students can take notes about their problem solving and what they have learned using a built-in word processor. Students can also

use a menu of verbs and phrases to construct a list of relevant problem-solving steps. For instance, "Read the problem," and "Identify the goal," are steps entered early in a list. By requiring students to generate these lists explicitly, students are forced to think back to their own activities to determine which are important in a problem-solving episode. It is assumed that this will facilitate the transfer of problem solving skills to new contexts.

Instructor Module

This module consists of several components that present problems to the student, monitoring his/her performance, making instructional decisions, and coaching the student through the problem-solving task. The tutor requires students to explicitly perform the skills in a way that the tutor can monitor. The tutor then diagnoses each action and takes the appropriate action. This provides a means of flexibility for individualizing the instruction for each student. Different approaches may be used by the system for different types of students learning at different times. Flexibility not only influences the initial applications of the tutors but also allows for extensions into related domains and adapts to the student and the problems they are trying to solve through the nature of the instruction given and the curriculum covered by the tutor.

RESEARCH DESIGN

Design Team

The overall FST project leaders, at Armstrong Laboratory, have built an interdisciplinary team that has developed and is field testing the programs in instructional settings. The team consists of mathematics, English and science teachers; computer programmers; graduate students with an education and training focus; educational psychologists; and management specialists. This team has refined the mathematics tutor from a research product to a product that can be used in a real-world application.

Local Participation...Research Population Expansion

After piloting the FST Project in the San Antonio Schools, the research team must implement the project in additional sites for the purpose of research data collection to determine the project's value to the broad audience of public schools, especially with "at risk" student populations. Following pre-experimental studies and small laboratory-like studies, conducted with 20-25 students to assess the initial effectiveness of the tutors and to ensure that the tutors were ready for large-scale implementation, the final set of field studies in which the tutors are used in regular classrooms over long periods of time will include the selected Dayton area schools.

This project includes research which will involve human subjects. Our organization does not have an accepted and currently valid general assurance on file with the Department of Health and Human Services; however, the project will not have any negative effect on the human subjects.

Dayton area school districts were selected for eligibility based on their designation by the Ohio Department of Education as "eligible for intervention" and/or their significant minority populations. School districts received the intervention designation based on their performance

on the Ohio Proficiency Test (fewer than 24% of the district's students passed after two tries). (SEE Appendix "A")

Environment

The activation of two separate school test sites will require the close coordination of the AL site requirements (necessary to ensure site independence for data integrity).

Implementation of the Intelligent Tutor System includes a requirement to create work stations and to ensure that the laboratory space meets certain essential research requirements for environment. The special laboratories being established as part of this grant are extraordinary for the eligible schools. The laboratories will be dedicated to this research project and will be fully utilized for the ITS projects for the duration of the grant.

The computer work stations required are absolutely essential to the performance of the data collection activity on intelligent tutor technology and educational effectiveness. By its very nature, the artificial intelligence-based system requires a state-of-the-art workstation using a 386-based processor and will not operate without that technology. Future enhancements to that system are planned by the Armstrong Laboratory project (included in the budget for option years two and three), and it is essential that this test site be absolutely compatible with not only the AL site, but also with all other test sites in the joint Laboratories' project.

In addition, it is absolutely essential to the success of this R&D project that data integrity be maintained, and that all sites be environmentally independent. That means that there can be no deviations from operating conditions among the sites which could result in significant differences in performance among the participants due to the local conditions--the measured differences in performance must be relatable to a very limited number of factors, and the broad-based experiment must have very tight control of extraneous parameters in order to maintain its scientific statistical significance. That means that each test site must provide an atmosphere which is conducive to learning, hence the need for subdued lighting, quiet surroundings, and moderate temperatures and humidity. Deviations from the environmental norms established by the AL scientists would result in extraneous parameters, thereby rendering the experiment void.

Data Collection and Reporting

All appropriate classes (pre-algebra, remedial algebra, algebra IA, etc. in each selected school will serve as subject participants in the project. Each participating class will be given pre- and post experiment standardized tests, problem-solving assessment tests, and student questionnaires. Each participating teacher will be given pre- and post-experiment questionnaires. Carefully selected control groups (demographics, size, etc.) will also participate in pre- and post-testing.

Computer-based, tutor-generated reports on student performance by course section will be communicated on a monthly basis to the San Antonio project team. At the end of each academic semester, one copy of the notebook files generated by each student using the tutor will be sent to AL/HRTI.

GRANTEE DESCRIPTION

The Dayton-Montgomery County Public Education Fund (Grantee; PEF) is a non-profit foundation which is a coalition of industry, education and government, acting as a third-party advocate to improve public schools, representing all constituencies. The PEF is independent of local school districts, but they work closely with all of the local districts. That autonomy provides a measure of detachment critical to unbiased and independent selection processes for this project. There is no other independent agency in this state like the PEF, except for another PEF in Cleveland, which has a similar charter for local schools advocacy.

The PEF is experienced with grants (especially educational-based grants) based upon its past seven years of activity in this arena. The PEF has the staff to respond quickly to the needs of a grant of this nature, which will be of necessity evolutionary as the AL project grows and develops. The organization has 7 year's experience in orchestrating cooperative teaching-based projects, such as the regional Project DISCOVERY (part of Ohio's National Science Foundation funded Statewide Systemic Initiatives program to improve mathematics and science education), teaching grants and awards, and Project GEMMA (Growth in Mathematics through a Mathematical Mentorship Alliance) in which the Wright Laboratory has participated for the past three years. The PEF is experienced in building bridges to and among school districts, which are often very independent and competitive. The success of this research project depends upon obtaining cooperation among the districts involved, a process which the government is not well-suited or prepared to undertake, but for which the PEF is eminently well-qualified. The PEF has built school districts' trust (largely through emphasis on the central role of teachers), enabling quick response which is essential to begin and then to operate a complex program such as the ITS in such a short time period.

GRANTEE RESPONSIBILITIES

The PEF will coordinate all facets of site selection, site preparation, technical assistance, teacher training, testing and reporting, and remuneration of participants.

Site Selection

The PEF, in consultation with the project research team, will develop site selection guidelines and communicate those to eligible school districts. The PEF will identify participant requirements and will design and implement site selection procedures, including application forms, an orientation session for teachers and administrators and recruiting and convening a broad-based committee of experts to advise the site selection. The PEF will ensure that sites are selected based upon general criteria of district eligibility (based on test scores and/or significant minority populations), school district proximity, site proximity, willingness and commitment to provide local support to the project, demographic mix, and control population potential, and research requirements.

Teacher Training and Support

The PEF will provide for teacher training for all the teachers actually using the ITS and for the site coordinators. Training will consist of at least one day of general familiarization on-site in the school during the summer, one full-week of training at the Armstrong Lab site in San Antonio, Texas in August, and additional training as needed as determined by the research team.

FST Proposal, 6/15/92

Administration of Tests and Communication of Data

The PEF will provide for the administration of standardized tests as needed for assessment of academic achievement improvement and will report test results regularly to the research team.

Staff and Technical Support

The PEF will provide or ensure appropriate staff support for all phases of the project's implementation: administrative, management and secretarial staff to support the site selection process; the purchase and installation equipment for laboratories; the teacher training component and research data collection and reporting; and all other activities to ensure successful project implementation and reporting. This will include any staff time required for coordination activity with potential industrial partners who may be interested in participating during the performance period. This also will include an on-site computer specialist at each school for immediate resolution of any hardware or software problems or questions. (This specialist should be in attendance during all class sessions and during teacher training, preparation and discussion meeting times.)

Administration of Grant Dollars

The PEF will administer all grant dollars to ensure the best possible potential for project success.

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COMPARISON OF MONTGOMERY COUNTY SCHOOL DISTRICTS

Ohio Ninth Grade Proficiency Tests

November 1990

TABLE 1

MONTGOMERY COUNTY

PERCENT WHO PASSED:

<u>District</u>	<u>Mathematics</u>	<u>Reading</u>	<u>Citizenship</u>	<u>Writing</u>	<u>Overall</u>
Brookville	49	88	70	81	38
Centerville	70	93	78	83	56
Dayton	16	57	24	53	10
Huber Heights	45	86	57	87	36
Jefferson	29	72	38	68	6
Kettering	64	88	72	82	53
Mad River	32	75	50	65	24
Miamisburg	48	88	70	80	38
New Lebanon	44	74	62	67	28
Northmont	56	89	69	88	47
Northridge	21	67	33	61	16
Oakwood	77	96	84	93	67
Trotwood-Madison	18	63	25	50	8
Valley View	56	89	62	89	43
Vandalia-Butler	63	86	69	83	51
West Carrollton	42	81	62	84	35

**COMPARISON OF MONTGOMERY COUNTY SCHOOL DISTRICTS
OHIO NINTH GRADE PROFICIENCY TESTS
NOVEMBER 1991**

TABLE 2

County=MONTGOMERY

District	Number Tested Writing	Number Passed Writing	% Passed Writing	Number Tested Reading	Number Passed Reading	% Passed Reading	Number Tested Math	Number Passed Math	% Passed Math	Number Tested Citizen	Number Passed Citizen	% Passed Citizen	Number Tested All	Number Passed All	% Passed All
Centerville City SD	498	407	82	501	479	96	500	401	80	500	404	81	495	305	62
Dayton City SD	1799	1147	64	1833	1044	57	2065	354	17	1937	577	30	1506	234	16
Huber Heights City SD	544	481	88	548	479	87	552	303	55	549	374	68	542	243	45
Kettering City SD	487	397	82	487	424	87	486	339	70	486	373	77	485	269	55
Miamisburg City SD	281	180	64	282	242	86	282	148	52	283	200	71	278	101	36
Northmont City SD	425	340	80	420	358	85	436	304	70	428	307	72	414	213	51
Oakwood City SD	116	105	91	116	110	95	116	96	83	117	101	86	116	84	72
Trotwood-Madison City SD	258	161	62	260	190	73	259	54	21	255	102	40	251	35	14
Vandalia-Butler City SD	289	224	78	293	256	87	295	197	67	292	230	79	288	144	50
West Carrollton City SD	286	239	84	287	243	85	291	149	51	289	219	76	284	119	42
Brookville Local SD	113	83	73	113	86	76	114	57	50	113	78	69	113	42	37
Jefferson Township Local SD	66	50	76	66	49	74	69	16	23	69	28	41	65	13	20
Mad River Local SD	274	221	81	277	218	79	300	123	41	291	184	63	258	87	34
New Lebanon Local SD	98	84	86	98	90	92	98	59	60	98	80	82	98	45	46
Northridge Local SD	134	73	54	137	107	78	139	42	30	136	93	68	132	24	18
Valley View Local SD	131	118	90	131	112	85	131	76	58	131	79	60	131	54	41

APPENDIX "C-1"

Project "F.A.S.T. Track" (Fundamental Algebra Skills Training) APPLICATION FORM

School District: Dayton Public Schools

Superintendent: James A. Williams Telephone: 513-461-3000

School: Dunbar Professional Address: 2222 Richley Avenue
Studies Magnet School

Principal: Leon Love Telephone: 513-268-6893

Mathematics Department Chair: Ron Rogacki Telephone: 513-268-6893

Site Coordinator Designee: Ronald Rogacki Telephone: 513-268-6893

Project Teachers (a minimum of 2):

Kaye Thomas Telephone: 513-268-6893 Jacqueline Bobo 268-6893

Carlyn Miller Telephone: 513-268-6893 Jacqueline Brown 268-6893

How many classes will use the facility each week? Minimum numbers: 5 teachers,
5 classes, 125 students.

Please describe the demographics of your district and why they demonstrate that this school should be selected as a pilot site for Project F.A.S.T. Track.

Dayton Public Schools, an America 2000 school district, is comprised of 27,660 students of whom 36% are white and 64% are minority. The characteristics of the district are typical of an urban school district with high percentages of economically-disadvantaged students. One of these characteristics is significant numbers of students achieving below national and state norms in mathematics. Although students have made recent gains on major performance indicators, there is clearly a need to continue to improve student achievement. Project F.A.S.T. Track would help to assist Dayton students in continuing to improve mathematics achievement and to implement the NCTM Standards. Dunbar High School has been selected for participation because its mathematics department has evidenced a successful two-year pilot project of Algebra for all 9th year students. Thus, the project would have the potential to reach significant numbers of underrepresented students who already view Algebra as an expectation. Describe the strengths which your district and/or this school brings to the opportunity for success with this project.

The district has set high expectations for all students in mathematics, evidenced by an Algebra I and Geometry graduation requirement beginning in the 92-93 school year. Dunbar High School has taken the lead by piloting this program in the 90-91 school year and brings the strength of implementation of a successful program to Project F.A.S.T. Track. Other strengths of Dunbar's mathematics department are: pilot site for Ohio State University's Computer/Calculator Pre-Calculus Project, winner of highest district award in mathematics for past three years, has shown greatest increase in California Achievement Test scores over past three years, department chairperson has won highest district award in mathematics and served as professional development consultant for incorporation of computers/calculators in the curriculum. Additionally, Dunbar's administrative team provides strong support and leadership to all departments.

Describe how this project will assist your district in its current and/or planned efforts for improving mathematics education.

This project will assist the district in its current efforts to implement Algebra I and Geometry as a graduation requirement. By offering challenging problem solving activities in a structured program, the district's Algebra I curriculum will be enhanced. Using technology will also provide experience which will assist students in higher level mathematics courses. Increases in CAT scores, proficiency test scores, success in Algebra I and higher level courses will be expected outcomes of the project.

Describe how the school district and participating teachers will ensure that teachers have adequate time to work together and with project and district support personnel to provide the best possible opportunity for success.

One of the factors cited by Dunbar's mathematics department for success with prior program initiatives has been the advantage of having a common planning and/or lunch period. This has given them the time they need to collaborate and work out solutions to problems. This arrangement will continue. Teachers have also agreed to meet four hours each month to formally discuss project implementation. Building administrators, central office staff, and university consultants will be available to support the project, as needed.

Describe how the school district will demonstrate its commitment to the success of the project, including what resources you agree to provide to the project (e.g., people, in-kind items, re-allocation of resources; maintenance/building staff to prepare dedicated classroom, district financing for site modifications and/or a partnership with the project to finance them, release time for teacher participants, etc.)

The district will provide all the requirements listed on page three of application. Additionally, the district will provide resources needed to modify classroom for project specifications, funds to support an additional participating teacher in the project so that the entire department can be included, stipends to teachers for extended time for project meetings (four hours monthly), continuing education units to participating teachers for training component and monthly meetings, and other supplies which teachers may need for successful program implementation.

Please identify any difficulties/challenges which you anticipate in successful implementation of this project in your district and/or at this school site (Be sure to consider the project requirements listed on page 3 as you respond here.)

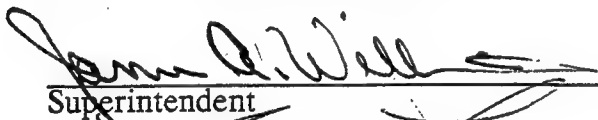
The only challenge viewed by the team is trying to schedule classes to ensure that all members of the department will be included in the project. The administrative team has participated in all planning for the project and will make every attempt to schedule each teacher at least one of the two-year Algebra I classes targeted for the project. Teachers also express a concern about the selection of a control group; they would like to have similar demographics represented in the control group.

Please attach a copy of the section of your district curriculum into which you plan to incorporate the Project F.A.S.T. Track program.

Requirements to which districts and participants must agree:

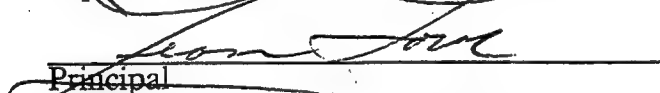
- Teachers will participate in project training in San Antonio in August.
- A site coordinator, who is an active teacher of mathematics in the building, will be released from teaching responsibilities to be available daily for a minimum of 2 periods per day.
- Project classes will be limited to no more than 25 students.
- Random selection of eligible students for the project classes.
- A control group, randomly selected from eligible students, preferably in the same building and of equal size to the project group.
- The district/school will provide a dedicated classroom and dedicated office space (coordinator) for the project.
- Building capacity to accept and then support the project
 - a. Electricity for computers and networking of them
 - b. Locally controlled heating and cooling
 - c. Two separate, dedicated phone lines
 - d. A security system
 - e. Carpeting
 - f. Subdued lighting
- District liability for the equipment (Insurance for equipment)


AGREEMENTS: By affixing our signatures, we assure that each of us has carefully reviewed this proposal and we support the descriptions and agreements described herein and agree to the requirements listed above. We also assure that we are willing to work with the Air Force and the Dayton-Montgomery County Public Education Fund to ensure that the program is a success. (The signatures of the superintendent, principal, mathematics department chair, and at least two teachers who will be involved in the program must be included.)

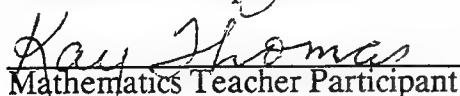

Superintendent

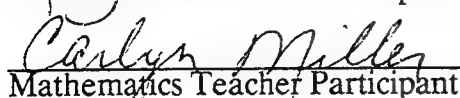
May 26, 1992

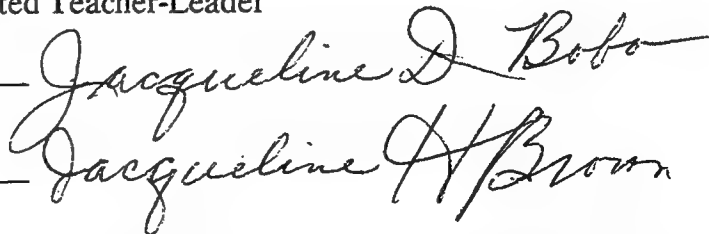

Date


Principal


Mathematics Department Chair or Designated Teacher-Leader


Mathematics Teacher Participant


Mathematics Teacher Participant

Submit proposals to The Dayton-Montgomery County Public Education Fund, 2100 Kettering Tower, Dayton, Ohio 45423 (222-2934) NO LATER THAN MAY 26, 1992.

APPENDIX "C-2"

Project "F.A.S.T. Track"
(Fundamental Algebra Skills Training)
APPLICATION FORM

School District: Trotwood-Madison City School

Superintendent: Dr. William Smith Telephone: 513-854-3050

School: Trotwood-Madison High School Address: 221 E. Trotwood Blvd., Trotwood, OH 45426

Principal: Dale Sterner Telephone: 513-854-0878

Mathematics Department Chair: Dean Aukerman Telephone: 513-854-0878 (school)
513-962-2843 (home)

Site Coordinator Designee: Michael Bader Telephone: 513-854-0878 (school)
513-278-2748 (home)

Project Teachers (a minimum of 2):

Dorothy Boike Telephone: 513-854-0878 (school)
513-429-9553 (home)

Stacy Robinson Telephone: 513-854-0878 (school)
513-274-1611 (home)

How many classes will use the facility each week? 4-5 classes

Please describe the demographics of your district and why they demonstrate that this school should be selected as a pilot site for Project F.A.S.T. Track.

The Trotwood-Madison City School District is a large suburban district with all the characteristics of an urban district. The student population of 4,100 students is comprised of 60% minority and 40% white students. More than half of the students are eligible for free or reduced breakfast and lunch programs. The district is a "micro-urban" school and community. Within the next 10 years, more of the country's schools will take on the appearance and characteristics of our district. T-M would be an excellent pilot site because it is large enough to have a diverse and representative population and still small enough to reasonably control outside variables. If there is to be a resolution of some of the academic problems facing our schools and communities, the solutions will have to be discovered within districts such as ours.

Describe the strengths which your district and/or this school brings to the opportunity for success with this project.

The school district, with outstanding community participation and support, is in the midst of a renewal program. The community residents and school staff have made a realistic and difficult attempt to face directly the problems facing schools and communities. Ignoring the issues does not bring about resolution. Community residents and school staff are working together to seek and discover a "better" method of delivering educational service in order that all children may learn to their maximum potential. Project F.A.S.T. Track will compliment the efforts currently underway within the district. Providing a strong partnership and sound research base to the renewal process is extremely critical to long-term success.

Describe how this project will assist your district in its current and/or planned efforts

for improving mathematics education. Students who took the Ninth Grade Proficiency for the first time in the last two years have scored below the state average on the Mathematics section and scored significantly lower on the Mathematics than on the other three sections. Community members, students, and school staff have reviewed and revised the mathematics curriculum, K-12 grades. Having the tools to provide students with enrichment and remediation in the development of mathematic skills would be extremely helpful in attempting to improve our students' ability to successfully master mathematics. Modern technology has provided numerous methods to assist students in academic progress. Project F.A.S.T. Track will assist our students and teachers in improving and learning of mathematics.

Describe how the school district and participating teachers will ensure that teachers have adequate time to work together and with project and district support personnel to provide the best possible opportunity for success.

Teachers and school staff have been involved in exploration, discussions, and planning for the application to Project F.A.S.T. Track from the very beginning. The high school principal will arrange and design the appropriate schedule that will enable participating staff to work together and meet the demands of the project. The excitement generated by the possibility of this project will continue to motivate teachers and administration to plan and work together.

Describe how the school district will demonstrate its commitment to the success of the project, including what resources you agree to provide to the project (e.g., people, in-kind items, re-allocation of resources; maintenance/building staff to prepare dedicated classroom, district financing for site modifications and/or a partnership with the project to finance them, release time for teacher participants, etc.)

The school district will provide the necessary people, time, and space to provide every opportunity for this project to be successful. The current plans will require the relocation of existing classes and teachers. Staff development funds will be used to supplement the necessary teacher training throughout the three-year project. Once the first year is started, plans will be made to make whatever building and schedule modifications necessary to implement the next stages of the project.

Please identify any difficulties/challenges which you anticipate in successful implementation of this project in your district and/or at this school site (Be sure to consider the project requirements listed on page 3 as you respond here.)

Three months is a very short time for implementation. I do not foresee any major difficulties of implementing the project if approved in the next few weeks. Our staff is excited about the possibilities and I am confident they will do whatever is necessary to provide for a smooth and successful implementation. Delivery and installation of equipment, installation of telephone lines, and minor modification of existing room is not completely within our control. We will do whatever possible to ensure the room is ready for the start of school.

Please attach a copy of the section of your district curriculum into which you plan to incorporate the Project F.A.S.T. Track program.

Requirements to which districts and participants must agree:

- Teachers will participate in project training in San Antonio in August.
- A site coordinator, who is an active teacher of mathematics in the building, will be released from teaching responsibilities to be available daily for a minimum of 2 periods per day.
- Project classes will be limited to no more than 25 students.
- Random selection of eligible students for the project classes.
- A control group, randomly selected from eligible students, preferably in the same building and of equal size to the project group.
- The district/school will provide a dedicated classroom and dedicated office space (coordinator) for the project.
- Building capacity to accept and then support the project
 - a. Electricity for computers and networking of them
 - b. Locally controlled heating and cooling
 - c. Two separate, dedicated phone lines
 - d. A security system
 - e. Carpeting
 - f. Subdued lighting
- District liability for the equipment (Insurance for equipment)

AGREEMENTS: By affixing our signatures, we assure that each of us has carefully reviewed this proposal and we support the descriptions and agreements described herein and agree to the requirements listed above. We also assure that we are willing to work with the Air Force and the Dayton-Montgomery County Public Education Fund to ensure that the program is a success. (The signatures of the superintendent, principal, mathematics department chair, and at least two teachers who will be involved in the program must be included.)

William E. Smith 5/26/92
 Superintendent Date

Dale Starn
 Principal

Mark F. Miller
 Mathematics Department Chair or Designated Teacher-Leader

Steve K. [unclear]
 Mathematics Teacher Participant

Robert A. [unclear]
 Mathematics Teacher Participant

Submit proposals to The Dayton-Montgomery County Public Education Fund, 2100 Kettering Tower, Dayton, Ohio 45423 (222-2934) NO LATER THAN MAY 26, 1992.

FUNDAMENTAL SKILLS TRAINING PROJECT (FST)

SITE PREPARATION MANUAL



**INTELLIGENT
TRAINING
BRANCH**

**BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS 78235**

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PREFACE

The goal of intelligent tutoring systems (ITSs) is to create automated teaching/training systems that deliver individualized instruction. These systems are possible through the application of artificial intelligence principles to computer-based training. Artificial intelligence (AI) technologies allow us to emulate a human teacher in the sense that such a system knows what to teach, how to teach it, and who is being taught. This requires representations of subject matter being taught, of multiple teaching behaviors, and of the student being taught. Such systems are to make judgments about what the student knows and how well the student is progressing. Instruction can then be tailored to the student's needs, automatically, without the intervention of a human instructor.

Intelligent Tutoring System (ITS) technology can be implemented in secondary and post-secondary educational environments, including fundamental literacy skills training. Potential instructional areas for this project include mathematics, reading, writing, and science. ITSs can be applied to many industrial training domains as well. The ITS technology developed for this project will be transferred from the Air Force to the public sector under the Technology Transfer Act.

This document is intended to be a guide to those working with us in establishing a particular test site. The requirements listed are based on our experience in building a test site "from scratch" here in San Antonio. In doing so, we were very aware of the lessons we'd learned from participating on other, less successful technology transfer activities. Though certain aspects of this model are intended to be flexible, the requirements listed here are, for the most part, considered essential to the success of a test site. Successful implementation of high technology involves more than just building the right software and buying the right hardware; it also means a commitment of space, people, and time. We have tried to be explicit about those needs in this document.

OVERVIEW

This paper is a guide assembled to assist an individual in creating a research site suitable for the implementation of the FST training system. It is only a guide. Portions and costs will vary depending on your location and needs.

We would offer some advice, however, to those of you new to managing resources from various sources. First, keep the lines of communication open; let all participants know what is going on and what is required of them. This cannot be stressed enough.

Second, dedicate an individual full-time for the procurement of computer equipment and peripheral items. Since this will become a full-time job for about 2 months of the project, it would be to your advantage to bring someone up to speed quickly.

Lastly, work closely with the site coordinator. He/she will have the potential to become your best friend or worst nightmare. It is absolutely crucial that the site coordinator believe in the project and be your advocate to administrators in charge of the physical site.

EQUIPMENT

1. General Features:

a. Furniture:

(1) 30 student desks (approximately 30"x 36") - construction should allow for all wiring to be out of sight; formica top is preferable. The desks should be built to allow a gap of 18" - 24" from the student to the screen.

(2) Printer Tables (dependent upon the number of printers required at the site).

(3) 31 five legged chairs with rollers (adjustable).

(4) 1 teacher desk.

(5) 1 work-station desk (30" x 72").

(6) 1 host table (30"x 36").

(7) 2 file cabinets.

(8) 1 wall clock.

b. Electrical:

(1) Install dedicated power line with surge protection.

(2) Install outlets as needed (1 per every 2 computers).

(3) Install dimmer switch on lighting.

(4) Run wires through desks (keep out of sight and out of reach).

c. Heating/Cooling:

(1) Install auxiliary heating and cooling system.

- Thermostatically controlled

-- Quiet - no window mounted units if possible

d. Phone:

(1) Install two telephone lines.

- 1 for host computer server system.

- 1 for voice transmission.

e. Security System:

(1) Install motion, sound, window and door detection security system.

(2) Door locks with limited access.

f. Classroom Support:

(1) Install white board.

(2) Install color-capable computer projection unit.

(3) Install overhead projector.

(4) Install projection screen (10 ft preferable).

g. Room Aesthetics:

- (1) Install glare reduction window shades (micro-blinds/and or drapes preferred).
- (2) Install carpeting.
- (3) Install sound-proof paneling (1.5' x 1.5' x 1.5').
- (4) Build 6 columns of 5 (1' x 1' x 1') shelves for storage of student belongings and computer work-station information and software.

2. Computer Equipment and Related Items:

a. Computer Work-stations:

(1) The hardware recommended to run the math tutor (pre-algebra word problem tutor) is the following:

- (a) 386 microcomputer running at 33 Mhz (the tutor will run on a 286, but very slowly).
- (b) 4 Mb extended memory (1 Mb required).
- (c) 5 Mb hard disk space.
- (d) EGA/VGA color monitor.
- (e) Mouse.

(2) If there are several machines at the site, a local area network (LAN) driven by an independent file server is recommended.

(3) In the future, with the incorporation Intel's Digital Video Interactive (DVI) technology, a DVI delivery board for each system will be required.

(4) If the Air Force supplies the computer equipment and it is valued at \$50,000 or greater, a loan agreement, approved at headquarters level, is necessary (expect 1-2 weeks to accomplish this). If the value of the computers is under \$50,000, your base LMCA can approve the loan agreement. Refer to Appendix A for a complete example.

b. Computer Software:

(1) The tutor software has been developed to run under DOS 4.0, however DOS 5.0 is preferred.

(2) The tutor is capable of running under DOS or Microsoft Windows. In the future, however, because of its flexibility in incorporating various multimedia operating environments, Microsoft Windows will be required.

PERSONNEL

A. Site Coordinator:

(1) A part-time position, serves as point-of-contact for the FST team; communicates with the Air Force team and internally to the site's organization (company, school...).

(a) Because of the importance of the site coordinator, here is the suggested verbiage to be used in creating the statement of work to be used in filling the position with contracting:

(a.1). MANAGEMENT OF T&E PHYSICAL PLANT.

- Oversight of site renovation or improvement prior to computer installation.

-- Provides Air Force site requirements to district officials.

-- Reports to Air Force on site renovation progress.

-- Advises Air Force of slippage in site renovation schedule or difficulties in acquisition.

-- Coordinates logistical arrangements to ensure physical plant is ready to accept computers on target implementation date.

- Facility management during test and evaluation period.

-- Advises district or contract maintenance personnel of computer failures.

-- Ensures performance of routine cleaning and upkeep of facility.

-- Ensures routine facility maintenance and upgrade where necessary; coordinates needs of individual teachers/students with District and Air Force personnel.

(a.2). COORDINATION BETWEEN AIR FORCE AND DISTRICT PERSONNEL.

- General activities.

-- Serve as primary point of contact between Air Force personnel and site personnel.

-- Serve as primary point of contact between Cooperative Research and Development agreement (CRDA) personnel and site personnel.

-- Advise the Air Force of scheduled distinguished visitor (DV) visits to the test site initiated by school district personnel.

-- Advise school district personnel (the principal of the school test site, at a minimum) of scheduled DV visits to the test site initiated by Air Force personnel.

-- Advise Air Force personnel of any concerns, questions, comments regarding test site administration (to include questions and concerns of personnel within the school district employed by the Air Force, such as teachers, subject matter consultants, etc....).

- Activities prior to the beginning of each test and evaluation period.

-- In conjunction with the appropriate Air Force and school district personnel, ensures teachers are properly assigned to administration of the test and evaluation.

-- In conjunction with the appropriate Air Force and school district personnel, ensures designated courses are properly scheduled for the academic year/semester in the test facility.

-- In conjunction with the appropriate Air Force and school district personnel, ensure appropriate pre- and post- baseline diagnostic measures are administered to designated students assigned to participate in the evaluation as control or experimental group members prior to the beginning of the evaluation period.

- Activities during each test and evaluation period.

-- Coordinates and schedules weekly meetings of evaluation team members; meetings may be held biweekly at the joint discretion of the site coordinator and the tutor development leader.

-- As needed, in conjunction with the tutor development leader, develop and facilitate agendas for weekly meetings.

-- Address specific questions, concerns, and requests of T&E personnel as needed throughout the test and evaluation period; primary role is to facilitate answers, not create them (i.e., ensuring that a request about tutor modification is routed to the tutor development leader).

-- Ensure that software-specific information relevant to the T&E process is routed from school personnel to Air Force personnel, and vice versa.

- Other duties as directed by the Project Manager.

B. Lab Technician:

A person that is computer literate; needs to be on-site with the instructor to load and download files and run the LAN.

~~C. Training Developers:~~ *Just*

(1) Two or more training developers may be needed depending on the amount of changes desired in the word problem database and the instructional statements; two are recommended to develop new problems, review and edit them, and to test them in the context of the tutor; if a large number of word problems are to be added (40 or more), more than two developers are suggested.

~~D. Subject Matter Experts:~~ *Just*

(1) Subject Matter Experts (SMEs) are essential for verifying information, reviewing problems contained in the word problem database, and ensuring the instructional content of the subject matter. The expertise of SMEs are typically contracted, therefore statements of work will need to be generated.

APPENDIX A
LETTER

Armstrong Laboratory/CC

Loan Agreement in Support of Fundamental Skills Project

AL/HRTI

1. Your request for a loan agreement with the North East Independent School District is approved through 15 June 1993.
2. Establish a loan jacket file IAW AFM 67-1, Vol I, Part One, Chapter 10. Establish a suspense to provide sufficient time for recovery of loaned items by the expiration date.

BILLY E. WELCH, Ph.D.
Director

- 2 Atch
1. Loan Agreement
 2. Equipment List

ATCH 1 LOAN AGREEMENT

PART I

A. Lending Organization:

Armstrong Laboratory
Human Resources Directorate
Technical Training Research Division
Intelligent Training Branch
Brooks AFB TX 78235-5601

B. Parent Command:

Air Force Systems Command
Andrews AFB MD 20334-5000

C. Authorized Borrower

Sage Educational Systems, Inc.
14007 Bluff Park
San Antonio, TX 78216

PART II

A. List of government property:

31 Microcomputers and 31 Monitors

Source of supply: Armstrong Laboratory
Human Resources Directorate

Technical Training Research Division
Intelligent Training Branch
Brooks AFB TX 78235-5601

B. Dollar Value: \$175,000

C. Time Period: 15 August 1991 - 15 June 1995

D. Purpose - Conduct field test in support of the Fundamental
Skills Training Project

PART III

A. No classified information or equipment will be required for performance
of this loan agreement.

B. The Air Force retains authority to participate in any technical accident
or incident investigation.

C. NA

D. NA

PART IV

A. This document constitutes a loan agreement between the Air Force and the authorized borrower named in paragraph I.C.

B. This loan is made under authority of 10 U.S.C., sections 8012(b), 931, and 9832, and AFM 67-1, Volume I, part one, chapter 10, section N.

C. NA

D. The borrower assumes full liability for property damage due to negligence or loss, and personal injury.

NOTE: Payment for repair of items caused by fair wear and tear listed in Part II.A., will be the responsibility of AL/HRTI

NOTE: All microcomputers and microcomputer monitors will be moved to the North East Independent School District's, MacArthur High School, Room 203.

E. The borrower is obligated to undertake all reasonable measures to protect all government property patent, and the government's industrial rights to the property.

F. The property will be returned in good condition (less fair wear and tear) as when loaned.

G. When in the best interest of the Government, the Air force reserves the right to terminate the agreement.

H. Title for the property loaned remains with the Air force.

I. The borrower agrees that no person(s) will be discriminated against in connection with the use made of the property on the grounds of race, color, religion, sex, or national origin, nor will any person(s) be denied the benefits of or be subject to discrimination under any program in that any activity, conducted, or use made of the property, by the borrower, will be in compliance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat238:25243 U.S.C. 2000d).

PART V.

A. This loan will have no effect on the operation of the Technical Training Research Division and/or Human Resources Directorate.

RODGER D. BALLENTINE, Colonel, USAF
Chief, Technical Training Research Division

Date

JOE A. REYES, JR
Chief, Logistics Material Control Activity

Date

B. NA

C. NA

PART VI.

A. Armstrong Laboratory's Human Resources Directorate

HAROLD G. JENSEN, Colonel, USAF
Director

Date

B. Authorized borrower

GEORGE M. STADLER
President, Sage Educational Systems

Date

BILLY E. WELCH, Ph.D.
Director

Date

PART VIII.

A. Date Issued: 15 Aug 91

B. Date to be returned: NLT 15 Jun 1995

ATCH 2 EQUIPMENT LIST

1. Machine Type: Comp-U-Add
CPU : 386
Quantity : 30

Serial Numbers EMAS

0466503	s014650
0466504	s014651
"	"

2. Monitors: Panasonic C1381
Quantity: 10

Serial Numbers EMAS

kk1140927	s014640
kk1141063	s014641
"	"

Monitors: Compu-Add VGA 51091
Quantity: 20

Serial Numbers EMAS

10704665	s004032
10705920	s004033
"	"

APPENDIX B
SITE DEVELOPMENT COSTS

Site Development Costs:

(A). Furniture:

- 30 student desks (30 @ 300)	\$8295.00
- Printer Tables (2 @ 150)	300.00
- 31 Chairs (30 @ 150)	4650.00
- 1 Teacher Desk	500.00
- 1 Work-station Desk (30" x 72")	300.00
- 1 Host Table (30" x 36")	200.00
- File Cabinets (2 @ 200)	1400.00
- 1 Wall Clock	20.00

SUBTOTAL \$15,665.00

(B). Electrical

- Dedicated Power w/Surge Protector	\$3328.00
- Subdued Lighting	2049.00
- Dimmer Switch	10.00

SUBTOTAL \$5,387.00

(C). Heating and Cooling

- Centralized Heating and Cooling	\$2,922.00
---	------------

(D). Phone

- Installation of 2 separate lines	\$ 200.00
(local telephone fees apply)	

(E). Security System

- Motion, sound, window & door	\$2000.00
- Extra protection door lock	50.00

SUBTOTAL \$2,050.00

(F). Classroom Support

- White Board	\$2000.00
- Color computer projection unit	3000.00
- Overhead projector	300.00
- Projection screen (10 ft)	791.00

SUBTOTAL \$6,091.00

(G). Room Aesthetics

- Micro Blinds	\$1000.00
- Carpeting	1400.00
- Sound-proof paneling	2000.00
- Storage shelves	100.00
- Windowed Door (For Observation)	40.00
- Intercom	83.00

SUBTOTAL \$4,623.00

(H). Computer Equipment and Operating System Software

- Work-stations	\$120,000.00
- Local Area Network	10,000.00
- Digital Video Interactive	40,000.00
- Software	5,000.00

SUBTOTAL\$175,000.00

TOTAL approx \$212,000.00



Serving Dayton and the Miami Valley

RECOMMENDATIONS FOR FST SITE PREPARATION

Submitted by Sue Rinehart

As revisions are made to the FST Site Preparation Manual, we suggest you bear in mind that individuals coordinating lab preparations may not be experienced in purchasing the kind equipment needed or in room renovation. Thus, we suggest the following be included in or with the manual:

- o Suggested timeline.
- o Sample drawings when possible (e.g., sample lab layouts and computer stations). Perhaps photos of some of the labs could even be included.
- o Hardware and software information. (Although the manual contains some information, it would have been helpful to have received the detailed Minimum Site Requirements earlier than August.)
 - o Be as specific as possible.
 - o What is essential and what is optional? (e.g., Norton Utilities, virus protection software?) When possible, include brief explanation of why it's needed.
- o Add "mouse pads" to the minimum site requirements.
- o Suggested manufacturers and models for equipment (e.g., overhead projectors and LCD units)--or at least specific features to look for. You may want to add a cart for the overhead projector as an optional purchase.
- o General guidelines about electrical needs for both computers and room. Perhaps include a list of suggested considerations such as whether the room will require additional outlets, whether the current outlets are grounded, and whether to have one or more master switches for computers (away from students or with "key switches"). Pros and cons of power poles?
- o Install hooks for students' coats and shelves for books as close to the door as possible.
- o List of general considerations such as recommended dimensions of room and stations. (e.g., It was extremely difficult to get the stations through the doors and up three flights of stairs into one of the rooms. Other sites probably have similar stories to tell.)
- o One-way glass for observing, if possible.
- o One or two phones per site.
- o Padded chairs recommended.

12/11/92

APPENDIX "F"

Intelligent Tutor Program

Proposal to the Engineering and Science Foundation

22 June 1992

Objective: To partner the Engineering and Science Foundation with the Air Force and the Public Education Fund in support of the Intelligent Tutor Program. Support is required for specific activities which the Air Force is prohibited from funding, and which are beyond the abilities of local public schools or the Public Education Fund to assume.

Background: The Air Force Wright Laboratory has recently become part of the Fundamental Skills Training joint research project initiated by the Armstrong Laboratory (AL) in San Antonio, the primary purposes of which are to verify the educational and training effectiveness of the Intelligent Tutor System and to transfer the technology to public education and to industry. The four AF Laboratories (including Phillips and Rome Labs) signed a Memorandum of Understanding to that effect in April 1992. In response to an increasing need for fundamental skills training and education in both the Air Force and public education, the Armstrong Lab has been conducting research for several years on artificial intelligence-based tutors, and since 1990 has been working with the San Antonio area public schools to develop the methods for application to public school education problems. The ITS developed by AL for remedial (9th grade) algebra was tested during the 91-92 school year, and is now ready for site-testing outside the San Antonio area. The second tutor being developed is a reading tutor which will be tested in San Antonio in the 92-93 school year and will be ready for site-testing in the 93-94 school year. The third tutor planned is a science tutor which will be ready for site-testing in the 94-95 school year.

Approach: The FST project involves the development of three intelligent tutoring systems. The first is a pre-algebra word problem tutor, which teaches students advanced problem-solving skills through the use of word (story) problems. The second tutor will facilitate the development of writing skills by guiding students through pre-writing, drafting, revision, and editing phases of the writing process. The third tutor will teach critical thinking skills in life science, chemistry, and physics. The tutors will be implemented in three stages in the local Dayton area public schools, one tutor each year, with each tutor being implemented for research data collection in its first year and then being transitioned to implemented status in its second year. After the first year's trial period for each tutor, the schools will assume operational responsibility for implementation. Hardware enhancements in the second year of the program are anticipated, where video-based instructional aides will be added if the necessary developmental testing at AL proceeds as planned. The implementation process will be organized and supervised locally by the Public Education Fund, which has prepared a plan for implementation of the ITS in two local schools, including plans for control groups for proper statistical evaluation, a selection process from among potential competing school districts, arrangements for purchase or lease of hardware and systems software for 60 386 processor-based computers, upgrade of facilities to the level necessary to guarantee site-independence from environmental factors, and appropriate management of the research project.

Specific Request: Approximately \$10,000 for air conditioning, carpet and miscellaneous general purpose equipment requirements.

The Air Force will provide funding for all aspects of the project except for equipment judged to be general purpose in nature, which includes carpeting and air conditioning for the computer laboratories. Public law forbids the Air Force to purchase general purpose equipment on research and development contracts and grants. Total project funding will be over \$300K in the first year, and about \$200K in each of the two option years. Of this amount, approximately \$10K will be for purchase of general purpose equipment, and it is that equipment funding which is requested from the Engineering and Science Foundation.

The requested equipment is needed because the local sites need to closely resemble the other test sites elsewhere in the country. Activation of two separate Dayton area school test sites will require close coordination of the Armstrong Lab site requirements with the potential local sites indicated by the school districts, in order to determine the actual requirements for modification and improvements to the testing labs. The minimum requirement for each of the testing laboratories will be a room sufficiently large to contain 30 student desks with hardware and associated furniture. Electrical, environmental control, security, instructional support, and aesthetics must be in accordance with the minimum requirements established by the AL testing site-independence protocol.

It is absolutely essential to the success of this R&D project that data integrity be maintained, and that all sites be environmentally independent. That means that there can be no deviations from operating conditions among the sites which would result in significant differences in performance among the participants due to the local conditions - the measured differences in performance must be relatable to a very limited number of factors, and the broad-based experiment must have very tight control of extraneous parameters in order to maintain its scientific statistical significance. That means that each test site must provide an atmosphere which is conducive to learning, hence the need for subdued lighting, quiet surroundings, and moderate temperatures and humidity. Deviations from the environmental norms established by the AL scientists would result in extraneous parameters, thereby rendering the experiment void. It is therefore a requirement that each laboratory room be equipped to the same minimum level of environmental control, necessitating procurement of floor covering, soundproofing, and air temperature and humidity control.



Dr. Wade Adams
WL/MLPJ
WPAFB, OH 45433-6533
(513) 255-6652 X 3171

SERVER

PRINTER

TEACHER STATION
& OVERHEAD
PROJECTOR

TEACHER DESK

TROTWOOD-MADISON HIGH
SCHOOL FLOOR PLAN

DOOR TO HALL

BOOKSHELVES W/CABINETS ABOVE

BOOKSHELVES W/CABINETS ABOVE

DOOR

BOOKSHELVES

BOOKSHELVES BELOW WALL OF WINDOWS

APPENDIX "H"

BUDGET & ACTUAL COST OF CLASSROOM RENOVATIONS

BUDGET ITEM	BUDGET/SITE	DUNBAR ACTUAL	TROT-MAD. ACTUAL
SITE DEVELOPMENT			
Furniture			
30 workstations	\$8,295	\$6,750	\$6,750
Printer support	300	60	0
31 chairs	4,650	2,613	2,613
Operator/Teacher Stations	1,000	0	576
File cabinets	400	199	199
Bookshelves (in stations)	0	376	364
Miscellaneous-Labor, wall clock, etc.	20	0	527
Subtotal Furniture	14,665	9,998	11,029
Electrical			
Dedicated power w/surge protector	2,000	960	667
Subdued lighting & dimmer switch	2,059	1,228	986
Subtotal Electrical	4,059	2,188	1,653
Other			
Heating & cooling	2,000	0	0
Demolition, preparation & paint	0	0	3,645
Built-in bookshelves	0	0	1,904
Security system	2,050	0	0
Walls/dividers	0	0	1,537
Door glass installation	0	0	40
Subtotal Other	4,050	0	7,126
TOTAL SITE DEVELOPMENT	\$22,774	12,186	\$19,808
SPECIAL TEST EQUIPMENT/ CLASSROOM SUPPORT			
Dot matrix printer	\$0	\$288	\$288
White board	2,000	500	309
Color computer projection unit	3,000	3,794	3,794
Overhead projector & cart	300	702	635
Projection screen	800	135	135
Install board and screen	0	0	99
Carpeting	1,400	2,460	1,789
Soundproof paneling	2,000	0	0
Miscellaneous (window blinds, electric broom)	0	263	0
Computer software	0	449	449
TOTAL EQUIPMENT/ CLASSROOM SUPPORT	9,500	8,591	7,498
GRAND TOTAL SITE PREP.	\$32,274	\$20,777	\$27,306

APPENDIX "I"

Project F.A.S.T. Track INVENTORY OF EQUIPMENT:

Dunbar High School
2222 Richley Avenue
Dayton, OH 45408
Room 310

DESCRIPTION	QUANTITY	MODEL/PRODUCT NO.	SERIAL NO.	UNIT VALUE	TOTAL VALUE
COMPUTER EQUIPMENT					
NCR, 486 25 MHz server, with 16 MB memory, one 1.44 MB flex disk drive, two 240 MB hard disk drives, one ethernet adaptor, two networking hubs with Novell Netware, DOS 5.0, WINDOWS 3.1 & a serial mouse.	1	3330-3500-8000	24005457	\$4,717.00	\$4,717.00
NCR 486 25 MHz client, with 4 MB memory, one 1.44 MB flex disk drive, one 120 MB hard disk drive, one ethernet adaptor, two ethernet hubs with Novell Netware, DOS 5.0, WINDOWS 3.1 & a serial mouse.	29	3330-3600-8000	24005458 24005459 24005460 24005461 24005462 24013076 24013077 24013078 24013079 24013080 24013081 24013082 24013083 24013084 24013085 24013086 24013087 24013088 24013089 24013090 24013091 24013092 24013093 24013094 24013095 24013096 24013097 24013098	\$2,743.00	\$79,547.00

I-1

DESCRIPTION	QUANTITY	MODEL/PRODUCT NO.	SERIAL NO.	UNIT VALUE	TOTAL VALUE
NCR VGA+ 14" color monitor.	30	3298-0231-8090	24013099		
			21838647	\$615.00	\$18,450.00
			21838596		
			21838604		
			21838597		
			21838071		
			21838628		
			21842253		
			21842256		
			21842257		
			21842258		
			21842259		
			21842260		
			21842262		
			21842263		
			21842264		
			21842265		
			21842267		
			21842269		
			21842270		
			21842271		
			21842272		
			21842273		
			21842274		
			21842275		
			21842317		
			21842912		
			21842925		
			21842928		
			21842764		
			21849430		
NCR Keyboards	\$30.00	G81-3077	122988E34	\$63.00	\$1,890.00
			120106E32		
			111127E17		
			111543E17		
			114643E17		
			111544E17		
			111908E17		
			119994E32		
			111984E32		
			117482E32		
			120129E32		
			119591E32		

DESCRIPTION	QUANTITY	MODEL/PRODUCT NO.	SERIAL NO.	UNIT VALUE	TOTAL VALUE
CITIZEN Dot Matrix Printer	1	GSX240	AKBH008002	\$288.25	\$288.25
SUB-TOTAL COMPUTER EQUIPMENT					\$104,892.25

I-3

OTHER EQUIPMENT

TELEX MagnaByte Computer Projection Panel w/VGA Cables	1	1000	10530	\$3,794.00	\$3,794.00
3M Enhanced Illumination Overhead Projector	1	955	923419	\$635.00	\$635.00
LUXOR 26" High Plastic Mobile Table	1	L26E		\$67.00	\$67.00
Claridge 4'x8' White LCS Deluxe Units With Aluminum Trim With Map Rail.	2	LCS2048R		\$500.00	\$1,000.00
Claridge 70"x70" Matt White MIRA Projection Screen.	1	MA7070		\$135.00	\$135.00
Computer Stations Manufactured by Dayton Showcase Co./All Plastic Laminate Construction.					
5' Teacher Desk	2			\$380.00	\$760.00
6' Double Computer Station w/Book Box	14			\$386.00	\$5,404.00

DESCRIPTION	QUANTITY	MODEL/PRODUCT NO.	SERIAL NO.	UNIT VALUE	TOTAL VALUE
3' Single Computer Station w/Book Box	1			\$287.00	\$287.00
Sub-Total Computer Stations					\$6,451.00
MARTIN two-drawer, gray file cabinet w/lock	2	MB720		\$99.49	\$198.98
Artco-Bell Chair; Shell-(K) Grey, Pad-(4) Dutch Holly Multi-colored	31	7590		\$84.30	\$2,613.30
SUB-TOTAL OTHER EQUIPMENT					\$14,894.28
GRAND TOTAL EQUIPMENT					\$119,786.53

APPENDIX "J"

YEAR ONE LOCAL TEACHING TEAMS

NAME	SCHOOL	ROLE
Jacqueline Bobo	Dunbar High School	Treatment Group Teacher
Jacqueline Brown	Dunbar High School	Treatment Group Teacher
Carlyn Miller	Dunbar High School	Treatment Group Teacher
Kay Thomas	Dunbar High School	Treatment Group Teacher
Ronald Rogacki	Dunbar High School	Site Coordinator
Leon Love	Dunbar High School	Principal
Dorothy Boike	Trotwood-Madison High School	Treatment Group Teacher
Kathleen Hepner	Trotwood-Madison High School	Treatment Group Teacher
Stacy Robinson	Trotwood-Madison High School	Treatment Group Teacher
Michael Bader	Trotwood-Madison High School	Site Coordinator
Dale Sterner	Trotwood-Madison High School	Principal

PROSPECTUS

OF A PROGRAM PLANNED FOR OHIO DEPARTMENT OF EDUCATION
APPROVED CONTINUING EDUCATION UNITS**FORM MUST
BE TYPED**Duplicate additional
copies for future use!Ohio Department of Education
Division of Inservice Education
65 South Front Street, Room 611
Columbus, Ohio 43266-0308

PART I. IDENTIFYING INFORMATION (Prospectus must be filled out completely)

A. 92-31-6000784
Provider Identification No.

B. Dayton Public Schools
Provider Agency Name

C. 2013 West Third Street / Dayton / OH / 45417-
Mailing Address City Office Of State Zip 2597

D. Laura M. Lansdown / Tim Rafferty / Employee Dev. / (513) 262-2907
Contact Person Position Telephone

PART II. PROGRAM INFORMATION

A. Fundamental Skills Training (FST) for Pre-Algebra Teachers
Program Title

B. 18.75 / MacArthur High/San Antonio, TX
No. of Contact Hrs. No. of CEUs Program Site

8/3/92 - 8/6/92
Date(s)

C. Please check (✓) the process which will be used to report the names, addresses, and social security numbers of persons who meet the attendance requirements for this program.

Electronic Transfer Address Sheets: No. Needed

D. List topic(s) or theme(s) to be addressed:
Fundamentals of Intelligent Tutor Interfaces; Implementation of computer tutor into
school curriculum; Research Evaluation Techniques; How to conduct laboratory
time with students

E. List major intended learning outcomes:
Curriculum/Instructional Enhancement; Computer Applications; Critical Technology
Evaluation Procedures

F. Identify instructional techniques or strategies that will be used to obtain the intended learning outcomes:
Hands-on Computer Experience; Lecture; Role Playing; Drill & Practice

—over—

G. Identify the assessment techniques or strategies that will be used to determine the achievement of the intended learning outcomes:

Questions & Answers (oral); Observation; Hands-on Application/demonstration;

Peer Critique

H. Program Description (Check one)

- | | | |
|--|---|---|
| 1. <input type="checkbox"/> Adult Development | 18. <input type="checkbox"/> Home Economics | 35. <input type="checkbox"/> Personnel |
| 2. <input type="checkbox"/> Assessment | 19. <input type="checkbox"/> Industrial Technology | 36. <input type="checkbox"/> Problem Solving |
| 3. <input type="checkbox"/> Business Management | 20. <input type="checkbox"/> Interpersonal Relations | 37. <input type="checkbox"/> Public Relations |
| 4. <input type="checkbox"/> Career Education | 21. <input type="checkbox"/> Intervention | 38. <input type="checkbox"/> Real Estate |
| 5. <input type="checkbox"/> Classroom Management | 22. <input type="checkbox"/> Kindergarten | 39. <input type="checkbox"/> School Finance |
| 6. <input type="checkbox"/> Communication Skills | 23. <input type="checkbox"/> Labor Relations | 40. <input type="checkbox"/> School Law |
| 7. <input checked="" type="checkbox"/> Computers | 24. <input type="checkbox"/> Learning Styles | 41. <input type="checkbox"/> School Reform |
| 8. <input type="checkbox"/> Cooperative Learning | 25. <input type="checkbox"/> Legal Issues | 42. <input type="checkbox"/> Science |
| 9. <input type="checkbox"/> Counseling | 26. <input type="checkbox"/> Library/Media | 43. <input type="checkbox"/> Social Studies |
| 10. <input type="checkbox"/> Curriculum | 27. <input type="checkbox"/> Management Skills | 44. <input type="checkbox"/> Special Education |
| 11. <input type="checkbox"/> Economics | 28. <input type="checkbox"/> Mathematics | 45. <input type="checkbox"/> Supervision of Instruction |
| 12. <input type="checkbox"/> Effective Schools | 29. <input type="checkbox"/> Mentor Training | 46. <input type="checkbox"/> Teaching of Reading |
| 13. <input type="checkbox"/> Effective Teaching | 30. <input type="checkbox"/> Motivation | 47. <input type="checkbox"/> Thinking Skills |
| 14. <input type="checkbox"/> Equity Issues | 31. <input type="checkbox"/> Non-English Speaking Students | 48. <input type="checkbox"/> Trade and Industrial Ed. |
| 15. <input type="checkbox"/> Food Service | 32. <input type="checkbox"/> Office Administration | 49. <input type="checkbox"/> Transportation |
| 16. <input type="checkbox"/> Gifted Education | 33. <input type="checkbox"/> Oral and Written Communication | 50. <input type="checkbox"/> Vocational Education |
| 17. <input type="checkbox"/> Health Services | 34. <input type="checkbox"/> Peer Coaching | 51. <input type="checkbox"/> Other _____ |

I. List major program presenters' names and qualifications. Staple continuation page, if necessary.

1. Major James Parlett, Ph.D. Teri Jackson, M.A.
2. Carolyn Pesthy, Ph.D. Linda Hunter, M.S.
3. Kent Steuck, Ph.D. Captain Mike Slaven, M.S.
4. Bob Patterson, Ph.D. Gary Ramah, M.S.
5. Wes Region, Ph.D.

PART III. PLEASE STAPLE COPY OF PROMOTIONAL MATERIAL AND TENTATIVE AGENDA FOR THIS PROGRAM TO THIS FORM.

NOTE: Only prospectus that fully meets the requirements stated in the guidelines will be considered for CEU credit.

AGENDA

FUNDAMENTAL SKILLS TRAINING (FST)

FOR PRE-ALGEBRA TEAMS

PRESENTED BY

ARMSTRONG LABORATORY

AUG 3, 1992 MONDAY

8:30 - 9:00	COFFEE / DONUTS
9:00 - 9:30	INTRODUCTIONS / ADMIN
9:30 - 11:00	FST OVERVIEW / PHILOSOPHY Maj Parlett, Ph.D.
(10:00 - 10:15)	BREAK
10:15 - 11:00	FST OVERVIEW CONTINUED Kurt Steuck, Ph.D.
11:00 - 12:00	TURN ON MACHINE "FUNDAMENTALS" -- Importance of Logon Numbers -- Assignment of Logon Numbers Carolyn Pesthy, Ph.D.

AUG 3, 1992 (cont'd)

12:00 - 1:00 LUNCH

1:15 - 2:15 LEARNING INTERFACES
Linda Hunter

2:15 - 2:30 BREAK

2:30 - 3:30 WORKING THROUGH PROBLEMS
"HANDS ON"
Linda Hunter

AUG 4, 1992 TUESDAY

8:30 - 9:00 COFFEE / DONUTS / GAME

9:00 - 10:00 STRATEGIES ON USES OF LAB TIME
Carolyn Pesthy, Ph.D.
Linda Hunter

10:00 - 12:00 EVALUATION CONCERNS
-- Testing Schedule
-- Testing Components
-- Pitfalls
Wes Regian, Ph.D.

(11:00 - 11:15) BREAK

12:00 - 1:00 LUNCH

AUG 4, 1992 (cont'd)

1:15 - 2:00

"COMMUNICATION"

- Scheduling visits to sites
 - Quarterly meetings
 - LAN address
 - Teach teachers chain of command
 - List of contacts
- Maj Parlett, Ph.D.
Teri Jackson

2:00 - 3:30

PROBLEMS "HANDS ON"

Kurt Steuck, Ph.D.
Carolyn Pesthy, Ph.D.
Teri Jackson

AUG 5, 1992 WEDNESDAY

8:30 - 9:00

COFFEE / DONUTS

9:00 - 10:30

"HANDS ON"

Kurt Steuck, Ph.D.
Carolyn Pesthy, Ph.D.
Teri Jackson

10:30 - 10:45

BREAK

10:45 - 12:00

"HANDS ON"

Kurt Steuck, Ph.D.
Carolyn Pesthy, Ph.D.
Teri Jackson

12:00 - 1:00

LUNCH

AUG 5, 1992 (cont'd)

1:15 - 3:15

CLASSROOM CONCERNS

- Grading
 - Lab Scheduling
 - Lab Rules
 - Testing Schedule Strategies
 - Assumptions
 - First Day Lab Procedures
- Carolyn Pasty, Ph.D.**

AUG 6, 1992 THURSDAY

8:30 -

COFFEE / DONUTS / ADMIN

Kurt Steuck, Ph.D.
Capt Mike Slaven

APPENDIX "L"

POSITION DESCRIPTION/COMPUTER TECHNICIAN

1.0 QUALIFICATIONS

1.1 General Qualifications

The person shall have an Associates technical degree (2-year) and two (2) years experience, or alternately one (1) year formal education in trade school, college or military training programs plus three (3) years experience in installation, software maintenance, and repair of personal computers, networks, and associated peripheral devices.

1.2 Specific Qualifications

This position requires extensive knowledge, skill and experience to solve common personal computer problems, software inoperability, and common peripheral device failures. Must have experience with WINDOWS version 3.1 or later, and MS-DOS version 5.0 or later. In addition, this person must be knowledgeable of, and skilled with Novell Netware to maintain both the hardware and software aspects of a PC LAN.

2.0 DUTIES AND RESPONSIBILITIES

2.1 Installs, maintains, and troubleshoots personal computers, networks, peripheral devices, and associated software.

2.2 Performs backups regularly, and periodically downloads designated files vital to the research project.

3.0 CONTROLS OVER WORK

3.1 Works under the administrative supervision of the Dayton-Montgomery Public Education Fund (PEF).

3.2 Receives all on-site technical assignments from a representative of either the PEF or FST Project, Wright-Patterson AFB.

3.3 Routine inspection for completeness and quality of work will be performed by the PEF.

4.0 PROCEDURES TO APPLY

4.1 Submit resume, transcript, two letters of recommendation, and three references who can speak to your professional skills.

4.2 Return those items listed in paragraph 4.1 to Dayton-Montgomery County Public Education Fund, 2100 Kettering Tower, Dayton, OH 45423 Attn: Sue Rinehart

The Dayton-Montgomery County Public Education Fund
An Equal Opportunity Employer

APPENDIX "M"
CONTRACT FOR COMPUTER TECHNICIAN'S SERVICES

DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND

CONTRACT NO. FST1020

1. INTRODUCTION

Whereas the parties hereto desire to enter into a contract for the furnishing of certain services and local travel for considerations set forth herein, it is agreed as follows:

This contract shall be between:

Dayton-Montgomery County Public Education Fund
2100 Kettering Tower
Dayton, Ohio 45423

(Herein referred to as PEF)

And:

SelectTech Services Corporation
4130 Linden Ave, Suite 115
Dayton, Ohio 45432

(Herein referred to as SelectTech)

Now, therefore, it is agreed as follows:

2. SCHEDULE

Item No.	Description	Total
<hr/>		
Basic Period		
	Provide the maintenance and operational support of the PEF's LAN system as defined in the Statement of Work (SOW) provided in Attachment A for the three month period 9 Nov 92 through 31 Jan 93.	
001	Technician III as defined in paragraph 4.0 of the SOW for up to 300 hours at \$26.24 per hour. If the Technician III is not available, provide a qualified Technician II at \$21.68 per hour or a Computer Operator III at \$26.24 per hour replacement.	\$7872.00
002	Travel	88.80
		<hr/>
Basic Period Total (Not To Exceed)		\$ 7960.80

Option I Period

Provide the maintenance and operational support of the PEF's LAN system as defined in the Statement of Work (SOW) provided in Attachment A for the period 1 Feb 93 through the end of the school year.

003	Technician III as defined in paragraph 4.0 of the SOW for up to 480 hours at \$26.24 per hour. If the Technician III is not available, provide a qualified Technician II at \$21.68 per hour or a Computer Operator III at \$26.24 per hour replacement.	\$12595.20
008	Travel	150.00
		<hr/>
Option Period Total (Not To Exceed)		\$12745.20
Program Total (Not To Exceed)		\$20706.00

3. TERMS AND CONDITIONS

3.1 Type of Contract

This contract is on a time and material basis.

3.2 Period of Performance

The services called for hereunder shall commence 9 November 1992 and continue through 31 January 1993. The place of performance will be either the Trotwood-Madison or Dunbar High Schools as scheduled by the PEF.

3.3 Allowable Charges

The total price for this contract shall not exceed \$7960.80. PEF shall not be obligated to make payments above this amount unless the total price has been increased by written amendments to this contract.

3.4 Invoicing

SelectTech will provide biweekly for approval at the following address an invoice for the services and local travel expended in the previous pay period:

Dayton-Montgomery County Public Education Fund
2100 Kettering Tower
Dayton, Ohio 45423
Attention: Deputy Program Manager

Invoices must include the following information:

- a) Company name
- b) Contract number
- c) period covered by the invoice
- d) Labor hours billed by category for both the current period and cumulative to date
- e) the local travel billed for both the current period and cumulative to date

3.5 Payment

Payment shall be made to SelectTech Thirty (30) days after receipt of approved invoice.

3.6 Personnel Approval

Resumes of all personnel assigned to provide services under the contract will be submitted to the PEF for approval prior to their working on the effort.

3.7 Options

The PEF Deputy Program Manager shall provide written notice to SelectTech extending the period of performance in accordance with

the contract no less than 15 calendar days prior to expiration of the contract. Pursuant to exercising the option of the contract, the PEF will issue the contract modification extending the period of performance to include that period for the Base period and Option I period at the prices in the Schedule and with no change to the Terms and Conditions.

3.8 Technical Direction

The PEF Technical Manager for this contract is Lt. N. Baerwald of the FST Project, Wright-Patterson AFB, Ohio. She will represent the PEF in all technical matters. Lt. Baerwald may be reached at (513) 255-2110 , ext 3172.

The designated Technical Manager is authorized to issue technical direction under the subcontract on behalf of the PEF. These directions may include instructions to SelectTech which provide details, suggest lines of inquiry, or otherwise complete the general scope of work set forth in Attachment A. These directions SHALL NOT constitute new assigned work, changes, modifications or amendments to this contract.

3.9 Contractual Direction

No modification of this contract, including the terms and conditions and the SOW, shall be binding on PEF unless agreed to, in writing, and signed by PEF. All correspondence or notifications involving contractual or financial matters should be addressed to:

Dayton-Montgomery County Public Education Fund
2100 Kettering Tower
Dayton, Ohio 45423
Attention: Deputy Program Manager

3.10 Overtime

Overtime shall be defined as authorized time worked in excess of forty (40) hours per week. No overtime will be used in the performance of this contract.

3.11 Laws And Regulations

SelectTech and its employees shall comply with all School regulations and procedures and with all Federal, State, and local laws applicable to the work being performed under this contract.

3.12 Travel

Local travel shall be reimbursed at the rate of \$.24 per mile of travel between work sites and between any one work site and Wright-Patterson AFB, Ohio. Billable local travel will occur only when work sites are changed during the working day or when a person has to be brought from Wright-Patterson AFB to one of the work sites. All billable local travel must have been approved by the PEF Deputy Program Manager or Executive Director.

ATTACHMENT A

STATEMENT OF WORK

1. General Information

The objective of this program is to obtain the non-personal support services necessary for the on-site support of certain computer software and hardware integration programs under the development of the Dayton-Montgomery County Public Education Fund (PEF). The support required will include the operational and maintenance of the Fundamental Skills Training Tutor (FSTT) software and NCR hardware being installed at two area high schools.

2. Scope

The scope of this effort includes the on-site labor necessary to support the personal computers, networks, peripheral devices and associated software being put into place at two area high schools to instruct and quantify the learning process.

3. Technical Requirements

3.1 Install, maintain, and troubleshoot the NCR hardware, the FSTT software, networks, and the peripheral devices on-site at the two area high schools.

3.2 Perform backups regularly, and periodically downloads designated files vital to the research project.

4. Personnel Qualifications

4.1 General Qualifications

The person assigned to this effort shall have an Associates technical degree and two years of experience, or alternatively four years of experience in installation, software maintenance, and repair of personal computers, networks, and associated peripheral devices.

4.2 Specific Qualifications

Personnel assigned to this effort are required to have extensive knowledge, skill and experience to solve common personal computer problems, software inoperability, common peripheral device failures. Must have experience with WINDOWS version 3.1 or later, and MS-

DOS version 5.0 or later. In addition, this person must be knowledgeable of, and skilled with Novell Netware or an equivalent LAN software package to maintain both the hardware and software aspect of a PC LAN.

5. Schedule

The contractor will provide support according to the schedule provided by the PEF at least two weeks in advance of the required support and will average above 20 hours a week during normal school week. The provided schedules are considered flexible and will be subject to change by the Deputy Program Manager as late as the day before performance. The contractor will observe all school holidays that are observed by the two area high schools that are involved in the research project.

6. Staffing

The contractor will provide one qualified person to be on site as required by the PEF provided schedule. To maintain continuity the contractor will identify its primary support personnel and provide qualified backup personnel when the primary person is not available. The PEF provided schedules will serve as written approval as to the total program hours that are required. Should these defined hours exceed 40 hours in a week, additional personnel will be assigned to the program as required.

7. Provided Facilities and Equipment

The PEF will provide working space for each member of the technical staff assigned to this project. This work space will be in the immediate area housing the systems being supported.

8. Travel

Local travel will be provided by the contractor and reimbursed at \$.24 per mile when the assigned support schedule requires the changing of high schools in the middle of the day. It will also include the mileage from WPAFB to the high school being supported when extra support has to be utilized. All local travel will be approved by either the PEF Deputy Program Manager or the Executive Director prior to its being provided.

9. Overtime

No overtime will be used in the performance of this effort.

IN WITNESS HEREOF, the parties hereto have executed this agreement.

Dayton-Montgomery County PEF

BY: Sue S. Elling 11/13/92
Sue S. Elling

TITLE: Executive Director

DATE: 11/13/92
2100 Kettering Tower
Dayton, Ohio 45423

SelectTech Services Corporation

BY: Robert B. Finch
Robert B. Finch, Ph.D.

TITLE: President

DATE: 24 Nov 1992
4130 Linden Avenue
Suite 115
Dayton, Ohio 45432

Dayton Foundation

BY: Marjorie L. Grossman

TITLE: Director of Administration

DATE: 11/13/92
2100 Kettering Tower
Dayton, Ohio 45423

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FUNDAMENTAL SKILLS TUTOR

Innovative Intelligent Tutoring

Transferring Air Force Technology to Schools



Cover Art

The drawing on the cover is a representation of the plaque given to both high schools during the dedication ceremony on 19 February 1993. This plaque symbolizes the commitment of Wright-Patterson

Air Force Base (Aeronautical Systems Center and Wright Laboratory), the community (Dayton-Montgomery County Public Education Fund and the Engineering and Science Foundation), and local business (NCR) to support the local schools and their commitment to excellence.

FST Requirements

The FST requires minimal hardware: IBM PC compatible, 386 based microcomputers with a color EGA or VGA monitor, 640 K RAM, 1 megabyte of extended memory and at least a 1 megabyte hard disk.

Further Information

For information about the FST software, contact Major Jim Parlett, (210) 536-2146.

For information about the Wright Laboratory FST Project, contact Lt. Nancy Baerwald (513) 255-2110 ex. 3172 or Sue Rinehart at the Dayton-Montgomery County Public Education Fund (513) 222-2934.

APPENDIX "N"

FUNDAMENTAL SKILLS TUTOR

Innovative Intelligent Tutoring

Local Test Sites

Dayton Dunbar High School

and

Trotwood-Madison High School

WHAT IS AN ARTIFICIAL INTELLIGENT TUTORING SYSTEM?

An Artificial Intelligent Tutoring System (ITS) is a computer application of artificial intelligence capable of delivering individualized instruction.

WHAT IS ARTIFICIAL INTELLIGENCE?

Artificial Intelligence (AI) involves the application of cognitive psychology to computer science. The computer is programmed with a model of human thinking and learning, allowing the computer to act as an "intelligent" human tutor for training and instruction.

HOW IS AN ITS DIFFERENT FROM OTHER COMPUTER-ASSISTED INSTRUCTION (CAI)?

An ITS is a "tutor in a box" because it emulates an effective human instructor. An ITS knows what to teach (via an embedded expert system); it knows how to teach (using varied strategies within the instructional model); and it knows who is being taught (by recording and analyzing a student model).

WHAT IS THE ADVANTAGE OF AN ITS?

The greatest advantage of an ITS is its capacity to dynamically adapt instruction to the individual. An ITS continuously assesses what a student knows, reinforces student thinking, based on feedback and learning styles, and varies the intervention of the tutor according to identified individual needs.

The effectiveness of one-on-one instruction is well documented by research. For example, in 1984 Dr. Benjamin Bloom found that the mean performance of students receiving individualized instruction was 48% higher than the mean of those receiving traditional group instruction. The ITS can greatly expand the ability of a teacher to provide individualized instruction to students and can provide important information to students and teachers to enhance classroom instruction.

THE WRIGHT LABORATORY FST PROJECT

Wright Laboratory (WL) is a premier Air Force laboratory employing over 3000 experienced scientists and engineers. WL's mission is to lead and focus the Air Force's aeronautical technology investment. As part of that mission, WL is dedicated to serving the community by sharing its technical resources with local schools to ensure our children receive the best possible education.

On 1 May 1992, WL entered into a Memorandum of Understanding with Armstrong Laboratory to support continued research and development in the area of intelligent tutoring. One of the key components of this Memorandum is Wright Laboratory's commitment to support two high school test facilities for FST evaluation in the Dayton area. On 24 July 1992, a 3-year grant for \$935,000 was awarded to the Dayton-Montgomery County Public Education Fund (PEF) to perform the research locally. The PEF is a coalition of corporate, foundation and education leaders, established in 1985 with the mission of keeping public education high on the civic agenda and improving education in public schools in Dayton and Montgomery County. Dayton Dunbar High School and Trotwood-Madison High School were chosen to participate by a panel of PEF and community representatives.

Despite the short time frame, local FST teachers participated in training in San Antonio, the Engineering and Science Foundation awarded a grant to enhance the labs and the PEF and WL set up two state-of-the-art computer labs for the 1992-1993 school year. With the help of NCR, sixty 486 based computers were delivered and networked by mid-October. Students were pre-tested in late October and began using the tutor during the first week of November.

The local project will span three years and include not only the word problem-solving tutor but also the reading/writing tutor and the science tutor. Project evaluation, being conducted by an independent organization, includes both treatment and non-treatment group data. At the end of three years, if the technology proves successful, it is the goal of the Air Force to spread this technology to school districts across the United States.



WHAT ARE THE FUNDAMENTAL SKILLS TUTORS (FST'S)?

- ♦ The Word Problem Solving Tutor will enhance problem-solving skills through mathematical word problems in pre-algebra.
- ♦ The Reading/Writing Tutor will develop logical thinking and communication skills by guiding users through the writing process.
- ♦ The Science Tutor will emphasize forming and testing hypotheses by analyzing, synthesizing, applying and evaluating information.

Each tutor will be developed by a team of math, English and science teachers, computer programmers, graduate students, educational psychologists, and management specialists. Using real-life scenarios, all three tutors will maximize a transfer of learning for both concepts and general knowledge.



Wright Laboratory

Fundamental Skills Training Project (Intelligent Tutor System)



APPENDIX "O"

19 February 1993

NCR World Headquarters Auditorium

Fundamental Skills Training Project

(Intelligent Tutoring System)

The Fundamental Skills Training Project utilizes technology being developed as a subset of artificial intelligence. The goal of an intelligent tutoring system is to develop individualized instruction. These systems are possible through the application of artificial intelligence principles to computer-based training. Artificial intelligence technologies allow us to emulate a human teacher in the sense that such a system knows what to teach, how to teach it, and who is being taught. This requires a computer representation of the subject area being studied (as well as the instructor's knowledge) and a dynamic model of the particular student being taught. Such systems make judgments about what the student knows and how well the student is progressing. Instruction is then tailored to the student's needs automatically without the intervention of a human instructor.

Program

Welcoming Remarks: Mr. C. Lester Smithers, Jr.
Deputy Director
Wright Laboratory

Remarks: Lt Gen Thomas R. Ferguson, Jr.
Commander
Aeronautical Systems Center

Dr. Phil Neches
NCR Senior Vice President
and Chief Scientist

Dr. Frank Holdraker
Chairman
Dayton-Montgomery County
Public Education Fund

Presentations: Lt Gen Thomas R. Ferguson, Jr.

Closing Remarks: Lt Gen Thomas R. Ferguson, Jr.

Tour of Computer Labs: Dunbar High School

Trotwood-Madison High School

Reception will follow at the schools.

APPENDIX "P"

DETAILED AGENDA FOR DEDICATION CEREMONY

FUNDAMENTAL SKILLS TRAINING PROJECT INTELLIGENT TUTOR SYSTEM

- 1130 (Mesdames Lewis and Koperski, etc., arrive for set-up.)
- 1215 (Guests arrive. Guests view video tape of computer labs playing in lobby area.)
- 1225 (Mrs. Lewis makes announcement for guests to move to the auditorium for program to begin. Participants gather inside room and line up to be escorted to the stage.)
- 1230 (Capt Fowler moves to the corner of the stage and on signal from the protocol officer says,) LADIES AND GENTLEMEN, PLEASE RISE. (Gen Ferguson, Mr. Smithers, Dr. Neches and Mr. Holdraker move to chairs on stage.)
- 1233 (Mr. Smithers moves to the podium.) LADIES AND GENTLEMEN, PLEASE JOIN ME IN RECITING THE PLEDGE OF ALLEGIANCE. (Face flag at attention.)

I PLEDGE ALLEGIANCE TO THE FLAG OF THE UNITED STATES OF AMERICA AND TO THE REPUBLIC FOR WHICH IT STANDS - ONE NATION, UNDER GOD, INDIVISIBLE, WITH LIBERTY AND JUSTICE FOR ALL.

PLEASE BE SEATED.

- 1235 GOOD AFTERNOON - I'M LES SMITHERS, DEPUTY DIRECTOR OF WRIGHT LABORATORY, AND I'M DELIGHTED TO WELCOME YOU TO THIS VERY SPECIAL DEDICATION TO HONOR THE PARTNERSHIP WITH THE COMMUNITY AND BOTH THE DAYTON AND TROTWOOD-MADISON SCHOOL DISTRICTS. THE FUNDAMENTAL SKILLS TRAINING PROJECT WAS INITIATED IN 1990 BY ARMSTRONG LABORATORY AT BROOKS AFB, TEXAS. THE TUTOR PROGRAM SPAWNED FROM OTHER ARMSTRONG LABORATORY-DESIGNED TRAINING SYSTEMS USED IN A VARIETY OF OPERATIONAL ENVIRONMENTS, SUCH AS WEATHER FORECASTING, AIRCRAFT ENGINE

MAINTENANCE, AND SATELLITE ORBITAL MECHANICS. HERE TO CELEBRATE WITH US TODAY ARE SOME IMPORTANT PEOPLE WHO HAVE HELPED US MAKE THIS PROJECT WORK.

PLEASE STAND AS I CALL YOUR NAME. I WOULD ASK THE AUDIENCE TO PLEASE HOLD ITS APPLAUSE UNTIL I'VE ACKNOWLEDGED ALL OF THESE FINE PEOPLE.

MR. "PEENO BASSANEE," NCR VICE PRESIDENT FOR STAKEHOLDER RELATIONS.

MR. RICHARD WOLF, PRESIDENT OF THE ENGINEERING AND SCIENCE FOUNDATION, WHICH AWARDED A GRANT THAT ASSISTED WITH THE RENOVATIONS OF THE CLASSROOMS.

DR. JAMES WILLIAMS, SUPERINTENDENT OF THE DAYTON CITY SCHOOLS.

DR. WILLIAM SMITH, SUPERINTENDENT OF THE TROTWOOD-MADISON SCHOOL DISTRICT.

THE HONORABLE RICHARD HAAS, MAYOR OF THE CITY OF TROTWOOD.

MAJOR JAMES PARLETT, CHIEF OF THE INTELLIGENT TRAINING BRANCH AT ARMSTRONG LABORATORY AT BROOKS AIR FORCE BASE, TEXAS.

MS. SUE ELLING, DIRECTOR OF THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND.

FINALLY, MS. SUE RINEHART, DEPUTY PROGRAM MANAGER OF THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND. (Applause.)

I WOULD NOW LIKE TO INTRODUCE SOMEONE WHO HAS BEEN ENTHUSIASTICALLY BEHIND THIS PROJECT FROM ITS CONCEPTION, OUR BOSS, THE COMMANDER OF

AERONAUTICAL SYSTEMS CENTER, LIEUTENANT GENERAL THOMAS FERGUSON. (Gen Ferguson moves to the podium.)

THE FUNDAMENTAL SKILLS TRAINING PROJECT IS AN EXCELLENT EXAMPLE OF WHAT WE IN THE AIR FORCE CALL "TECHNOLOGY TRANSFER." MANY IN THE GOVERNMENT AND AIR FORCE RECOGNIZED THAT THE BASIC TECHNOLOGIES THAT THE AIR FORCE HAD DEVELOPED HAD BEEN APPLIED TO CONSUMER PRODUCTS FOR EVERYDAY USES. PRODUCTS RANGING FROM MICROWAVE OVENS TO AUTOMOTIVE PARTS TO THE BEST GOLF CLUBS AND TENNIS RACKETS HAVE LINEAGES THAT TRACE BACK TO THE AIR FORCE'S SCIENCE AND TECHNOLOGY PROGRAM.

WE BEGAN TO REALIZE THAT WE COULD IMPROVE OUR NATION'S STANDARD OF LIVING AND INCREASE OUR COMPETITIVENESS GLOBALLY IF WE COULD INCREASE THE EFFICIENCY OF THIS TRANSFER OF TECHNOLOGY FROM THE DEFENSE INDUSTRY TO THE CONSUMER PRODUCTS SECTOR.

THE FUNDAMENTAL SKILLS TRAINING PROJECT BEGAN AS AN AIR FORCE SCIENCE AND TECHNOLOGY PROGRAM AT ARMSTRONG LABORATORY. ITS POTENTIAL TO ENHANCE EVERYDAY LIFE WAS RECOGNIZED AND EACH OF THE AIR FORCE'S FOUR "SUPERLABS" CREATED A TEAM TO TRANSFER THIS TECHNOLOGY TO SCHOOLS IN THEIR LOCAL COMMUNITIES. EACH TEAM CONTAINED MEMBERS FROM THE SUPERLAB, LOCAL EDUCATION ORGANIZATIONS, AND PRIVATE INDUSTRY. THE IMPORTANT THING TO REMEMBER ABOUT THIS PROGRAM IS THAT SO MANY PEOPLE FROM DIFFERENT ORGANIZATIONS AND BACKGROUNDS WORKED SO WELL TOGETHER TO MAKE THESE FUNDAMENTAL SKILLS TRAINING FACILITIES A REALITY. AS YOU HAVE AN OPPORTUNITY TO WALK THROUGH THE FACILITIES AT DUNBAR AND TROTWOOD-MADISON LATER IN THE PROGRAM AND TALK TO THE STUDENTS AND TEACHERS, I KNOW YOU WILL AGREE WITH ME THAT THE HARD WORK AND EFFORT PUT FORTH BY THE MEMBERS OF OUR TEAM IN DAYTON WAS WORTH IT. THE

FUNDAMENTALS SKILLS TUTORS PROVIDE AN ADDITIONAL TOOL FOR THE TEACHERS TO USE AND ENHANCE OUR LIVES THROUGH THE ENRICHMENT OF OUR CHILDREN.

I THINK THAT MOST WOULD AGREE THAT SUCH AN APPLICATION OF TECHNOLOGY WAS IN MANY WAYS INEVITABLE. THROUGH COOPERATION AND A TEAM APPROACH, WE CAN HAVE IT TODAY. BY TAKING ADVANTAGE OF THE TECHNOLOGY THE AIR FORCE HAS TO OFFER, DUNBAR AND TROTWOOD-MADISON HIGH SCHOOLS HAVE IMPROVED THE QUALITY OF THE EDUCATION GIVEN TO THEIR STUDENTS TODAY. INDEED, THEY HAVE GAINED A COMPETITIVE ADVANTAGE OVER OTHER SCHOOLS BY BECOMING MEMBERS OF AN ELITE GROUP OF SCHOOLS IN THE COUNTRY WITH THIS SYSTEM TODAY.

THIS IS JUST A SINGLE EXAMPLE OF HOW AIR FORCE SCIENCE AND TECHNOLOGY CAN MAKE A DIFFERENCE. I CHALLENGE EACH OF YOU TO FIND AREAS WHERE WE CAN HELP AND WORK WITH AERONAUTICAL SYSTEMS CENTER'S WRIGHT LABORATORY TO HELP MAKE GOOD THINGS LIKE THE FUNDAMENTAL SKILLS TRAINING PROJECT HAPPEN FOR ALL OF US. (Gen Ferguson returns to his seat and Mr. Smithers proceeds to the podium.)

ALSO WITH US TODAY IS NCR'S SENIOR VICE PRESIDENT AND CHIEF SCIENTIST, DR. PHIL NECHES. NCR HAS TEAMED WITH WRIGHT LABORATORY TO ENSURE STUDENTS IN THIS PROJECT RECEIVE "FST" INSTRUCTION ON THE BEST COMPUTERS AVAILABLE. (Invite Dr. Neches up to say a few words.)

THANK YOU, MR. SMITHERS. I'D LIKE TO WELCOME ALL OF YOU TO NCR.

I WAS INTERESTED IN GENERAL FERGUSON'S DISCUSSION OF THE TRANSFER OF TECHNOLOGY FROM THE AIR FORCE TO THE CIVILIAN SECTOR. COMMERCIAL AIR TRAVELERS OWE A GREAT DEAL TO THE AERONAUTICAL RESEARCH

CONDUCTED BY THE AIR FORCE. BUT SO, APPARENTLY, DO GOLFERS AND TENNIS PLAYERS. AS AN EX-PHYSICIST, I HAVE AN IDEA OF WHAT THE CONNECTION BETWEEN AIRPLANES, TENNIS RACKETS, AND GOLF CLUBS MIGHT BE, BUT I'D BE INTERESTED IN HEARING MORE ABOUT IT, GENERAL.

LIKE THE AIR FORCE, PRIVATE INDUSTRIES SUCH AS NCR ARE WELL AWARE OF THE VALUE OF TECHNOLOGY TRANSFER. WE ARE ESPECIALLY INTERESTED IN THE BENEFIT OUR TECHNOLOGY PROVIDES FOR OUR "STAKEHOLDERS."

WHEN JOHN H. PATTERSON FOUNDED NCR 109 YEARS AGO, HE UNDERSTOOD THAT THE COMPANY'S SUCCESS DEPENDED ON MANY GROUPS. THESE GROUPS INCLUDED NOT ONLY CUSTOMERS, BUT ALSO EMPLOYEES, SUPPLIERS, SHAREHOLDERS, AND COMMUNITIES. TODAY, NCR USES THE TERM "STAKEHOLDERS" TO DESCRIBE ALL THOSE WHO HAVE A STAKE IN THE COMPANY'S FORTUNES. WE CONSIDER THEM SO IMPORTANT TO OUR SUCCESS THAT WE HAVE MADE THEM THE BASIS OF OUR MISSION STATEMENT: "TO CREATE VALUE FOR ALL OF OUR STAKEHOLDERS."

THE DAYTON COMMUNITY, LIKE THE OTHER LOCAL COMMUNITIES IN WHICH NCR OPERATES, IS A VALUED STAKEHOLDER.

OVER THE YEARS, NCR HAS FOUND THAT, ASIDE FROM BEING THE *RIGHT* THING TO DO, SUPPORTING OUR COMMUNITIES IS A *GOOD* THING TO DO, FROM A PURELY BUSINESS STANDPOINT. BY SUPPORTING OUR COMMUNITIES, WE ALSO HELP OURSELVES: WE CAN WORK MORE EFFECTIVELY IN A STRONG COMMUNITY; WE CAN SELL OUR PRODUCTS MORE SUCCESSFULLY IN A STRONG COMMUNITY; AND, WE CAN ATTRACT TALENTED PEOPLE MORE EASILY TO A STRONG COMMUNITY. AS JOHN H. PATTERSON USED TO SAY, "IT PAYS."

NOTHING STRENGTHENS A COMMUNITY MORE THAN QUALITY EDUCATION. AND -- AS AMERICANS INCREASINGLY REALIZE -- THE SAME IS TRUE FOR OUR NATION AS A WHOLE. IF WE ARE TO COMPETE SUCCESSFULLY IN THE NEW GLOBAL ECONOMY, THE EDUCATION AND TRAINING THAT WE PROVIDE FOR OUR YOUNG PEOPLE MUST BE SECOND TO NONE. AS A HIGH-TECHNOLOGY COMPANY, NCR IS PARTICULARLY DEPENDENT UPON THE QUALITY OF ITS WORK FORCE. THUS, WE ARE PARTICULARLY INTERESTED IN IMPROVING THE BASIC SKILLS OF TODAY'S STUDENTS -- WE ARE COUNTING ON THEM TO BE TOMORROW'S ENGINEERS, COMPUTER SCIENTISTS, BUSINESS LEADERS ... AND CUSTOMERS.

FOR THAT REASON, WE ARE PARTICULARLY PLEASED TO HAVE CONTRIBUTED TO THE FUNDAMENTAL SKILLS TRAINING PROJECT. THIS IS OUR KIND OF PROJECT -- USING TECHNOLOGY TO BUILD THE SKILLS NEEDED TO DEVELOP EVEN BETTER TECHNOLOGY. HUNDREDS OF STUDENTS AT DAYTON DUNBAR AND TROTWOOD-MADISON HIGH SCHOOLS ARE RECEIVING ALGEBRA INSTRUCTION FROM AN ADVANCED INTELLIGENT TUTORING APPLICATION THAT RUNS ON NCR PC'S. OTHER "TUTORS" FOR DEVELOPING WRITING AND SCIENCE SKILLS ARE ON THE WAY.

IT'S ALSO OUR KIND OF PROJECT FOR ANOTHER REASON. AS A TECHNOLOGY PROVIDER, NCR KNOWS THE VALUE OF ALLIANCES AND PARTNERSHIPS. IN TODAY'S COMPLEX WORLD, IT USUALLY TAKES THE COMBINED EFFORTS OF MANY GROUPS TO ACCOMPLISH GREAT THINGS. THAT WAS TRUE FOR THE "FST" PROJECT, WHICH RESULTED FROM THE COMBINED EFFORTS OF THE AIR FORCE AND ITS ARMSTRONG AND WRIGHT SUPERLABS; THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND; DAYTON AND TROTWOOD-MADISON HIGH SCHOOLS; AND NCR.

THROUGH THIS PROJECT, ALL OF US HAVE A STAKE IN EDUCATING THE STUDENTS UPON WHOM AMERICA ...

DAYTON ... AND NCR WILL DEPEND FOR TECHNOLOGICAL LEADERSHIP IN THE 21ST CENTURY. THROUGH THEM, WE ARE ALL STAKEHOLDERS IN THE FUTURE. THANK YOU. (Mr. Smithers returns to the podium.)

FINALLY, I WOULD LIKE TO INTRODUCE MR. FRANK HOLDRAKER, CHAIRMAN OF THE BOARD OF THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND. THE PEF HAS BEEN PRIMARILY RESPONSIBLE FOR PULLING THIS PROJECT TOGETHER. (Invite Mr. Holdraker up to say a few words.)

THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND IS A COALITION OF CORPORATIONS, FOUNDATIONS AND EDUCATORS DEDICATED TO IMPROVING PUBLIC SCHOOLS THROUGH CONNECTIONS WITH THE BROADER COMMUNITY. SINCE 1985, THE PUBLIC EDUCATION FUND HAS WORKED TO FACILITATE THESE CRITICAL CONNECTIONS BECAUSE WE BELIEVE THAT PUBLIC SCHOOLS ARE NOT ONLY THE PROPERTY OF BUT MORE IMPORTANTLY THE RESPONSIBILITY OF THE COMMUNITY AS A WHOLE, NOT JUST THE EDUCATORS IN THEM.

THIS FUNDAMENTAL SKILLS TRAINING PROJECT VERY SPECIFICALLY ADDRESSES MANY OF THE PUBLIC EDUCATION FUND'S GOALS TOWARD THIS MISSION: TO GENERATE AND BROKER RESOURCES FOR AND COMMUNITY INVOLVEMENT IN PUBLIC SCHOOLS AND TO PROMOTE COMMUNICATION AND COOPERATION AMONG STAKEHOLDERS IN PUBLIC EDUCATION.

THE FUND HAS WORKED WITH WRIGHT LABORATORY ON A NUMBER OF EFFORTS OVER THE LAST SEVERAL YEARS, AND THE RELATIONSHIP WHICH WE HAVE DEVELOPED THROUGH THIS WORK LED TO OUR FST PARTNERSHIP. WE AT PEF BELIEVE THAT THIS KIND OF TECHNOLOGY TRANSFER IS ESSENTIAL TO THIS COUNTRY'S SCHOOL TRANSFORMATION EFFORT. WHETHER WE ARE LOOKING TO ACHIEVING THE EDUCATION 2000 GOALS (INCLUDING THE UNITED STATES BEING FIRST IN THE WORLD IN

MATHEMATICS AND SCIENCE EDUCATION BY THE YEAR 2000), OR WHETHER WE ARE CONCENTRATING ON LOCAL OHIO PROFICIENCY TEST SCORES OR PRODUCING GRADUATES OF OUR AREA'S SCHOOLS WHO ARE PROBLEM SOLVERS FOR THE 21ST CENTURY, IT IS CLEAR THAT A SUCCESSFUL EFFORT MUST COME FROM THE TOTAL COMMUNITY...BRINGING THE RESOURCES OF THAT TOTAL COMMUNITY TO THE SCHOOLS.

WE HAVE SOME WONDERFUL, TALENTED AND DEDICATED EDUCATORS IN OUR SCHOOLS. YOU'LL HAVE THE OPPORTUNITY TO MEET SOME OF THEM AND SEE THEM IN ACTION TODAY. IF THEY ARE CONNECTED TO AND SUPPORTED BY RESOURCES AND CURRENT TECHNOLOGY, THERE IS NO LIMIT TO WHAT THEY CAN DO!

THE DAYTON-MONTGOMERY COUNTY PUBLIC EDUCATION FUND IS PROUD TO BE A PARTNER IN THIS MODEL PROJECT. (Mr. Smithers returns to the podium.)

AT THIS TIME I WOULD LIKE TO ASK GENERAL FERGUSON TO COME FORWARD FOR THE PRESENTATIONS. (General Ferguson moves to the podium.)

I WOULD ASK THAT DR. WILLIAMS, SUPERINTENDENT OF THE DAYTON PUBLIC SCHOOLS, AND DR. SMITH, SUPERINTENDENT OF THE TROTWOOD-MADISON SCHOOLS, JOIN ME HERE ON STAGE. (Capt Fowler hands plaques to General Ferguson.) I HAVE PLAQUES TO PRESENT TO BOTH OF YOU THAT HAVE BEEN DESIGNED TO SHOW THE PARTNERSHIP BETWEEN WRIGHT-PATTERSON AIR FORCE BASE, LOCAL BUSINESSES, AND LOCAL SCHOOLS. WHEN YOU GET TO YOUR SCHOOL THIS AFTERNOON, I WOULD ASK THAT YOU PASS YOUR PLAQUE ON TO THE PRINCIPAL TO BE HUNG IN THE COMPUTER LAB AS A SYMBOL OF THIS PARTNERSHIP.

Note

(Superintendents will acknowledge their teams by asking them to stand and will focus comments on this opportunity for students and teachers to work in state-of-the-art

computer laboratories, with cutting-edge, Air Force technology. Mr. Smithers returns to the podium.)

I HAVE AN IMPORTANT TASK THAT I ALMOST FORGOT. MR. HOLDRAKER, WOULD YOU PLEASE JOIN ME AT THE PODIUM. (Capt Fowler moves forward with the check and pillow.) ON BEHALF OF WRIGHT LABORATORY, I WOULD LIKE TO PRESENT A CHECK FOR ONE HUNDRED THOUSAND, THREE HUNDRED AND TWENTY-SEVEN DOLLARS TO THE DAYTON-MONTGOMERY PUBLIC EDUCATION FUND FOR INCREMENTAL FUNDING FOR THE FUNDAMENTAL SKILLS TRAINING PROGRAM.

Note (Mr. Holdraker briefly acknowledges the gesture and returns to his seat.)

I WOULD LIKE TO THANK NCR FOR HOSTING THIS DEDICATION, THE MEDIA FOR COMING OUT TO SUPPORT THIS COMMUNITY EFFORT, AND THE COMMITTEE WHO MADE THIS PROGRAM HAPPEN. I WOULD LIKE TO NOTE THAT WITHOUT THE SUPPORT OF THESE PEOPLE, WE WOULD NOT HAVE BEEN ABLE TO PULL OFF THE SMALL MIRACLE WHICH YOU WILL SOON SEE. IN JUST SIX MONTHS THIS COMMUNITY WORKED VERY HARD WITH WRIGHT LABORATORY TO DESIGN AND INSTALL TWO EXTRAORDINARY COMPUTER LABS, AND INTRODUCED OVER 300 STUDENTS TO THEIR NEW COMPUTERS AND SOFTWARE WHICH WILL SUPPLEMENT THE EXISTING MATH, READING, AND SCIENCE CURRICULUM.

1310 AT THIS TIME YOU WILL HAVE THE OPPORTUNITY TO TOUR THE COMPUTER LABS. WE HAVE BUSES OUTSIDE TO TAKE YOU TO ONE OF THE SCHOOLS SO THAT YOU CAN INTERACT WITH STUDENTS AND TEACHERS. THE PLAQUES WILL BE PRESENTED TO THE CLASSES TO DISPLAY ON THEIR WALLS. THE BUSES WILL RETURN YOU TO NCR AT 2:30 P.M.

Note (One Air Force bus will be marked to go to Dunbar and the other will be marked to go to Trotwood-Madison High

Schools. Programs identical at both schools.)

(Superintendent will invite Air Force personnel to assist in presenting plaque to principal and teaching team to be hung on walls and acknowledge the school's commitment to the project. Principal will hang plaque when received, introduce teachers and students, acknowledge teachers' commitment to the project, invite guests to interact with teachers and students, and invite everyone to enjoy refreshments.)

APPENDIX "Q-1"

ARTICLE IN DAYTON DAILY NEWS

June 9, 1992

Permission to reprint granted by the DAYTON DAILY NEWS 8/94

8B □ TUESDAY, JUNE 9, 1992 •

Air Force to provide tutoring by computer

2 school districts to be chosen for help

Two local school districts are expected to be chosen Wednesday to participate in a computer-training program designed to improve math, reading and writing skills with software provided by the U.S. Air Force.

The Air Force will select two of four Montgomery County school districts for its Fundamental Skills Training Project, Northridge Schools Superintendent Clarence Jarboe said during Monday's board of education meeting.

The districts being considered are Dayton, Jefferson Twp., Trotwood and Northridge, according to Jarboe.

The project would involve a loan of 30 personal computers to each school. The math program, teaching pre-algebra, would be installed during the coming school year. The writing program would be available for 1993-94 and the reading program for 1994-95.

Trotwood Superintendent William E. Smith said the four schools were chosen because their students experienced difficulty on math proficiency tests. He said students in San Antonio participated in the original project and the results were encouraging.

Jarboe said the Air Force is working with staff from the Dayton Public Education Fund on the selection, and he expects announcement of the results by Thursday.

Jarboe said the Air Force is sponsoring the program to help school districts better prepare potential recruits. A study will be done, measuring the success of the program, which involves an intelligent tutoring system, delivering individualized instruction via computer.

Air Force officials could not be reached for comment Monday.

APPENDIX "Q-2"
ARTICLE IN TROTWOOD INDEPENDENT
August 12, 1992

Permission to reprint granted by the TROTWOOD INDEPENDENT 8/94

T-MHS to participate in new WPAFB program

More than 200 Dayton area ninth graders will be tutored in math starting this fall thanks to an Air Force project called Fundamental Skills Training (FST). On July 24, the Wright Laboratory (WL) here awarded a \$275,000 grant to the Dayton-Montgomery County Public Education Fund (PEF) which will administer the program.

FST is an Air Force response to the increasing need for fundamental literacy skills training for both Air Force recruits and public school students. FST's primary goal is to research, develop and transfer intelligent tutoring systems (ITS) to public education systems. Air Force researchers will collect data from the schools' program to improve intelligent training systems for personnel in the Air Force as well as the private sector.

Dayton Dunbar and Trotwood-Madison high schools were selected to participate in the computer-based test program, according to Sue Elling, project director for PEF.

The first year of the Dayton program will use a pre-algebra word-problem tutor. In addition to teaching students how to solve specific word problems, the tutor also teaches general problem solving strategies. The project has second and third year options to tutor writing and science.

"What we'd like to see is a tangi-

ble, measurable improvement in the math test scores of ninth graders," said Dr. Wade Adams, a senior WL scientist. "A secondary benefit should be a broader improvement in the students' abilities to solve any problem. Math word problems are more difficult for teachers to teach and students to solve. And yet this is what kids will deal with for the rest of their lives."

Although new to Dayton, FST is in its second year. The program was developed at Armstrong Laboratory, Brooks AFB in San Antonio, Texas, and was tested last year at MacArthur High School there, according to 1st Lt. Nancy Baerwald, FST project engineer in WL.

The system will not replace the human teachers, just help track student progress and identify areas of weakness. The computer actually makes a judgment about what the student knows, how well the student is progressing and then tailors instruction to the student's needs automatically.

The program uses ITS computer technology which incorporates artificial intelligence (AI) to administer individualized instruction. AI technologies allow a computer to emulate a human teacher, in the sense that such a system knows what to teach, how to teach it and

who is being taught.

"ITS will work wonders in classrooms where the peer pressure sometimes suppresses our natural curiosity — people often are just plain afraid to raise their hands with the answer or with an important question," said Col. David A. Herrelko, WL commander. "With FST, students can take risks they would never take in an open forum and advance at their own pace."

The success of such programs has been documented and is used in such Air Force and NASA operational environments as weather forecasting, aircraft engine maintenance, space shuttle fuel cell operations and satellite orbital mechanics.

"ITS represents one of those rare breakthrough opportunities which can revolutionize high school education in our community," said Col. Richard Paul, deputy chief of staff for science and technology for Air Force Materiel Command here. "We simply must capitalize on this opportunity for technology transfer."

The grant will pay for 30 computers for each school, technical assistance, teacher training and administrative costs, according to Lieutenant Baerwald.

WL is part of Aeronautical Systems Center with headquarters at Wright-Patterson AFB at the Air Force Materiel Command.

Schools have fresh ideas for new year

Districts take initiatives in math, writing education

By Fred Lawson
DAYTON DAILY NEWS

A computer-based tutoring mathematics program, made possible by an Air Force test project, will be used by some Trotwood-Madison High School students this year.

It also will be used in Dunbar High School in Dayton.

Schools throughout the area are starting the new year with new ideas and programs.

■ Northmont schools have reorganized gifted education.

■ Jefferson Twp. schools have secured grants for programs in the visual arts, foreign languages and conflict management.

■ Brookville schools have a new elementary gifted program.

■ Schools in New Lebanon will start a new writing program in the fourth and seventh grades.

■ Milton-Union schools will implement new state language arts and mathematics programs.

The Air Force program in Trotwood uses intelligent tutoring systems computer technology which incorporates artificial intelligence to administer individualized instruction, according to the Air Force.

Artificial intelligence technologies allow a computer to emulate a human teacher, in the sense that such a system knows what to teach, how to teach it, and who is being taught, Air Force officials said.

The system will not replace the human teachers, just help track student progress and identify areas of weakness.



The computer actually makes a judgment about what the student knows, how well the student is progressing and then tailors instruction to the student's needs automatically.

The program is made possible by a \$275,000 grant from the Wright Laboratory at Wright-Patterson Air Force Base to the Dayton-Montgomery County Public Education Fund, which will administer the program.

The grant will pay for 30 com-

BACK TO SCHOOL

□ Schools

CONTINUED FROM/1

puters for each school, technical assistance, teacher training and administrative costs, according to an Air Force announcement.

The project is called Fundamental Skills Training.

Air Force researchers will collect data from the schools' programs to improve intelligent training systems for personnel in the Air Force as well as the private sector, officials said.

"I think it's going to be a very exciting program," said William E. Smith, Trotwood-Madison superintendent.

A room in the central unit of Trotwood-Madison High School is being refurbished for the program. It is expected to be ready when students begin classes Monday.

The district also is working with the Miami Valley Head Start organization in an attempt to start more Head Start units in the district. Units are currently in Townview and Shilohview elementary schools, Smith said.

He said consideration is being given to starting Head Start at Broadmoor, Westbrooke Village and Olivehill elementary schools.

The district is expected to have about 4,000 students, about the same as last year.

ARTICLE IN DAYTON DAILY NEWS
"NEIGHBOR" SECTION
August 19, 1992

Permission to reprint granted by the
DAYTON DAILY NEWS

February 20, 1993

Permission to reprint granted by the DAYTON DAILY NEWS

Metro Today

Program computes for schools

Air Force, NCR team up

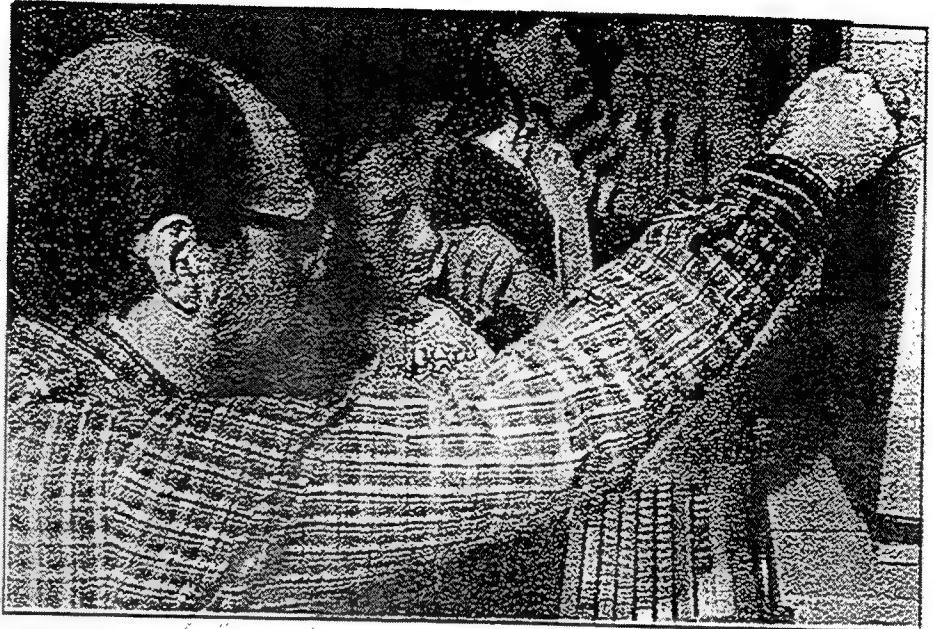
By Mary McCarty
DAYTON DAILY NEWS

You can't fool your teacher — especially when that teacher possesses artificial intelligence.

Three hundred ninth-graders at Dunbar and Trotwood-Madison high schools won't be able to fake understanding of their algebra lessons, thanks to high-powered computers donated through an experimental Air Force program.

"If a teacher asks a class at 2 o'clock on a Friday afternoon if anyone doesn't understand, not one student will raise his hand," says Lt. Nancy Baerwald, a computer information specialist for Wright Laboratory at Wright-Patterson Air Force Base. "But the computer doesn't allow you to lie. You can't brush the problem off until next time, because you can't progress until you've solved the problem."

The Intelligent Tutor System, as it is called, uses artificial intelligence to give students individual instruction. "The beauty of the artificial intelligence is that it teaches the way a teacher does," says Wade Adams,



BILL GARLOW/DAYTON DAILY NEWS

Gregg Anderson of Wright Laboratory helps Antoine Dunson, 14, at Dunbar High

the Wright Laboratory scientist who got the program rolling last May. "The computer is learning about the student just as the student is learning about math, and it gives hints to the student appropriate to his level."

Known as Fundamental Skills Training, the program is an unusual collaboration among Wright Laboratory, NCR Corp. and area public schools. Wright Laboratory awarded a \$935,000 grant to the Dayton-Montgomery County Public Education Fund — a public education advocacy group — to administer the program.

NCR sold the 60 top-of-the-line computers to Wright Laboratory at cost and also provided free installation and ongoing technical troubleshooting.

After a dedication ceremony at NCR World Headquarters on Friday, Pino Bassani, vice president for the company's Stakeholder Relations Division, explained the company's involvement: "Motivating students is the whole trick. The PC is a toy that will help them to become interested in their studies and start them on an upward educa-

SEE COMPUTERS/2B

Computers

CONTINUED FROM 1B

tional spiral."

The Air Force developed the software for the computerized tutorial to train new recruits. Baerwald and Wright Laboratory will collect data from the high school computers to improve software training for Air Force personnel.

With all this win-winning going on, perhaps the most surprising thing is that students are the biggest winners.

"I used to think word problems were hard, but now they're getting easier for me," says Dunbar ninth-grader Antoine Dunson, 14. "When you get the problem wrong, the computer gives you hints, so you

don't get discouraged so easily. And coming into the computer room is way more fun than being in class."

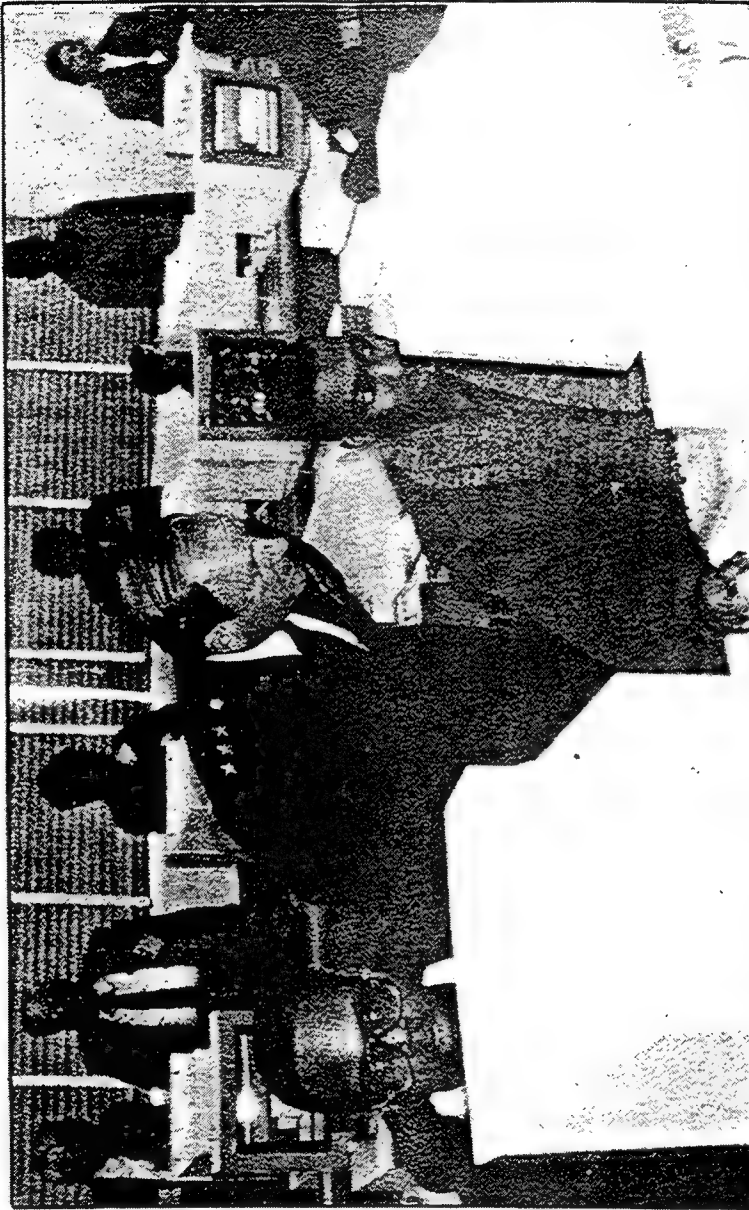
Reading and writing software will be introduced in the two high schools this fall, and science programs will be introduced in the fall of '94. However, area teachers aren't worried they'll be replaced by computers.

"Did the microwave take the place of the stove?" says Dunbar math teacher Carlyn Miller. "This is an added hand for the teacher, but it can't take the place of the teacher. Because at some point the computer's help function runs out and it says, 'Ask the teacher.'"

Fundamental Skills Training Program dedication ceremony

The Trotwood-Madison Senior High School Fundamental Skills Training (FST) computer lab was the site of a dedication ceremony on Friday, February 19, 1993. Officials from The United States Air Force as well as NCR and both Trotwood-Madison City Schools and Dayton City Schools first gathered at the NCR World Headquarters Auditorium to officially dedicate the lab sites. Lieutenant General Thomas R. Ferguson, Jr., Wright-Patterson Air Force Base, presented both Trotwood and Dayton Dunbar with plaques. After the presentation at NCR the audience proceeded to the school of their choice in order to view the labs in action.

The grant for this project was awarded to Trotwood-Madison Senior High School and Dayton Dunbar this past spring with Air Force funding of \$375,000 over a three year period. The three year project began this fall with the math tutor and will expand next year into reading and writing, and the following year into science. The primary goal of the FST project is research, develop,



LIEUTENANT GENERAL Thomas R. Ferguson, Jr., Commander, Aeronautical Systems Center, United States Air Force, inspects the Intelligent Tutor System being demonstrated by Willie Ellison (left) and Dana Smith (right).

and transfer three intelligent Robinson are the instructors tutoring system to public involved with the Fundamental Skills Project. Mr. Michael

Mr. Dorothy Boike, Mrs. Bader is site coordinator for Kathy Hepner, and Ms. Stacy the FST project.

United States Air Force



Certificate of Appreciation

to

For Participation in the
Fundamental Skills Training Project

Date

James W. Parlett
James W. Parlett, Maj, USAF
Chief, Intelligent Training Branch

APPENDIX "R"

Project F.A.S.T. Track

**Local Assessment:
Year One**

Word Problem Solving Tutor

July 14, 1993

Submitted by

Katie Thorp
Associate Research Engineer
University of Dayton Research Institute

ABSTRACT

The U.S. Air Force's Armstrong Laboratory in San Antonio, TX is developing a series of computer based tutors which use ITS technology to aid in education of high school students. Wright Laboratory in Dayton, OH volunteered to help in determining the effectiveness of these tutors as they are developed. In order to facilitate this process, Wright Laboratory obtained the assistance of the Alliance for Education. The Alliance has prepared this assessment of the initial phase of the tutor project in order to determine both the effectiveness of the tutor and the effectiveness of its implementation locally.

One purpose of this evaluation project was to determine the effectiveness of the WPS tutor at meeting the following goals:

Increase student -

- test scores in algebra
- ability to solve word problems
- interest in math
- interest in school
- enthusiasm for learning

Increase teacher -

- enthusiasm for teaching
- self esteem while teaching in a 'high-tech' environment

Another goal of this evaluation was to determine the effectiveness of our local implementation of the FST Project and to determine any improvements which could be made to make implementation of the future phases of FST more successful.

Based on the results of this assessment, the project can be considered to be a success at increasing teacher enthusiasm for teaching, teacher self-esteem while teaching in a 'high-tech' environment, and student enthusiasm for learning. The student questionnaire results indicate that, in general, the students had a positive impression of the tutor. The actual effectiveness of the tutor at improving test scores will not be evident until the testing data is released from Armstrong Lab. If enthusiasm and desire to continue to use the software is a judge, then the FST project can be considered a success.

SUMMARY

The teachers generally felt that the tutor had a positive impact on both their students and their own teaching abilities.

All the teachers in the project expressed an interest in continuing to use the tutor beyond the time required for the assessment procedure.

Enthusiasm and desire to continue to use the tutor next year, indicate a success both on the part of the software development and on the implementation of the FST project.

The initial training sessions were extremely difficult for many of the teachers and they did not enter the computer lab with a positive self-image. However, the project proved to be one of extreme personal growth for many of these teachers as they stretched themselves to meet the needs of their students.

As the students began to master the problem solving steps reinforced in the tutor, they became more confident and would attempt more word problems in the classroom as well as in the lab.

Based on these results, the project can be considered to be a success at increasing teacher enthusiasm for teaching, teacher self-esteem while teaching in a 'high-tech' environment, and student enthusiasm for learning.

The student questionnaire results indicate that, in general, the students had a positive impression of the tutor.

The actual effectiveness of the tutor at improving test scores will not be evident until the testing data is released from Armstrong Lab.

If enthusiasm and desire to continue to use the software is a judge, then the FST project can be considered a success.

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GLOSSARY OF TERMS

FST = Fundamental Skills Training Project. This is an acronym used by Armstrong Lab to indicate the computer tutor development project for public schools. The fundamental skills to be addressed in the project include; word problem solving, reading/writing, and life sciences.

WPS = Word Problem Solving. This is the initial tutor developed for FST.

ITS = Intelligent Tutoring Systems. This is a branch of artificial intelligence which uses the principles of computer science, educational psychology and cognitive psychology.

Student logs = A portion of the WPS Tutor software package. At the end of each working session on the tutor the students were asked to make comments in their personal logs.

Student reports = A report generated by the WPS Tutor which displays student progress.

INTRODUCTION

The United States Air Force's Armstrong Laboratory in San Antonio, TX is developing a series of computer based tutors which use ITS technology to aid in education of high school students. Wright Laboratory in Dayton, OH volunteered to help in determining the effectiveness of these tutors as they are developed. In order to facilitate this process, Wright Laboratory obtained the assistance of the Alliance for Education. The Alliance has prepared this assessment of the initial phase of the tutor project in order to determine both the effectiveness of the tutor and the effectiveness of its implementation locally.

PURPOSES

One purpose of this evaluation project was to determine the effectiveness of the WPS tutor at meeting the following goals:

Increase student -

- test scores in algebra
- ability to solve word problems
- interest in math
- interest in school
- enthusiasm for learning

Increase teacher -

- enthusiasm for teaching
- self esteem while teaching in a 'high-tech' environment

Another goal of this evaluation was to determine the effectiveness of our local implementation of the FST Project and to determine any improvements which could be made to make implementation of the future phases of FST more successful.

METHODS

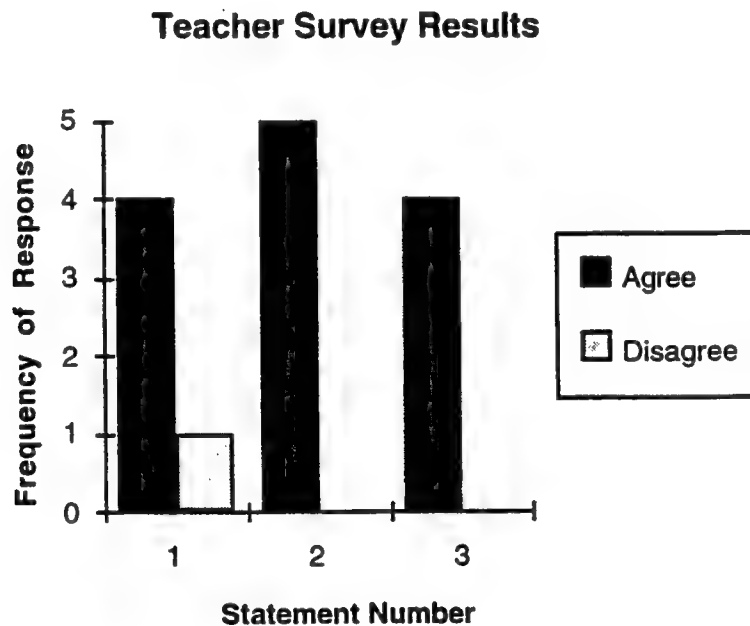
The most significant portion of the evaluation of the effectiveness of the WPS tutor was undertaken by Armstrong Lab personnel. That evaluation involves pre-, mid-, and post-testing of students who had access to the tutor as well as similar students who received only traditional instruction. Pre- and post- attitudinal surveys were also administered. Teacher records of topics covered and time-on-task were monitored. The results of this part of the evaluation are not yet available. A report of findings is expected in August of this year.

In order to minimize duplication of effort as well as imposition on classroom time, our local assessment efforts were focused on teacher opinion and attitude. Teacher attitude was recorded at group meetings and through private questionnaires. A short student questionnaire was also administered to measure student enthusiasm. Some student logs were inspected to note student feelings on a day by day basis. In addition, some student reports were inspected to aid in determining student progress on the tutor.

FINDINGS

Teacher enthusiasm for the project is the most easily 'measured' value of success. It allows us to make a qualitative judgment about the project's effectiveness and perception. The teachers generally felt that the tutor had a positive impact on both their students and their own teaching abilities (see Figure 1). All the teachers in the project expressed an interest in continuing to use the tutor beyond the time required for the assessment procedure. In general, they found the tutor to be a welcomed reinforcement of the problem solving procedures required for algebra story problems. Enthusiasm for the project increased throughout the year and seemed to climax during the last few weeks. This enthusiasm and desire to continue to use the tutor next year, indicate a success both on the part of the software development as well as on the implementation of the FST project.

Figure 1 -



Statements:

1. I feel that this project has had a positive impact on my students.
2. I feel that this project has had a positive impact on my teaching abilities.
3. I am satisfied with the way this project was organized.

Initially, many of the teachers expressed concern regarding their abilities to teach using a computer, primarily due to their personal lack of experience with computers. The initial training sessions were extremely difficult for many of the teachers and they did not enter the computer lab with a positive self-image. However, the project proved to be one of extreme personal growth for many of these teachers as they stretched themselves to meet the needs of their students.

The apparent high point of the enthusiasm came as a result of the version of the tutor which was installed during the last semester at each test sight. This most recent version of the tutor included a tutorial section at the beginning of each new topic. The

teachers found this advancement to be a helpful addition. The tutorial could be used to reinforce material which had been covered in the classroom. This made for a more coherent interface between classroom activities and computer lab sessions.

The teachers reported that the students were enthusiastic about going to the computer lab. As the students began to master the problem solving steps reinforced in the tutor, they became more confident and would attempt more word problems in the classroom as well as in the lab. Student confidence and pride is evident in many of the student log entries.

Based on these results, the project can be considered to be a success at increasing teacher enthusiasm for teaching, teacher self-esteem while teaching in a 'high-tech' environment, and student enthusiasm for learning.

The software solved the algebraic equations for the students once they had written them. Initially, this was a criticism of the project because it eliminated the students need to do the actual math involved in solving the problems. The teachers, however, found this to be an asset of the program because it allowed the students, and the teachers, to concentrate on the problem solving process rather than the result. This enabled many of the students to achieve success when they would have otherwise been limited by their lack of basic math skills.

The structured nature of the problem solving steps embraced by the tutor required that the students complete each stage of the problem solving process before continuing on to the next (i.e., the goal must be defined before the variables can be identified). Some of the teachers found this to be an asset because it forced the students to progress in an orderly fashion. However, those students who found it difficult to conform to this type of regimentation, did not seem to adjust well to the tutor. The greatest success of the tutor is probably obtained with students who are self-motivated and who receive gratification through personal improvement.

Because each student works on the computer at their own pace, the teacher is free to help those students who need more assistance. The slower students are not as rushed as in traditional instruction and the rest of the class does not get held-up by these slower students. Students are not as intimidated about asking for help from the teacher because they know that their classmates around them are working on another problem and they will not know what is causing them confusion. The computers free-up the teacher and allow for more one-on-one instruction.

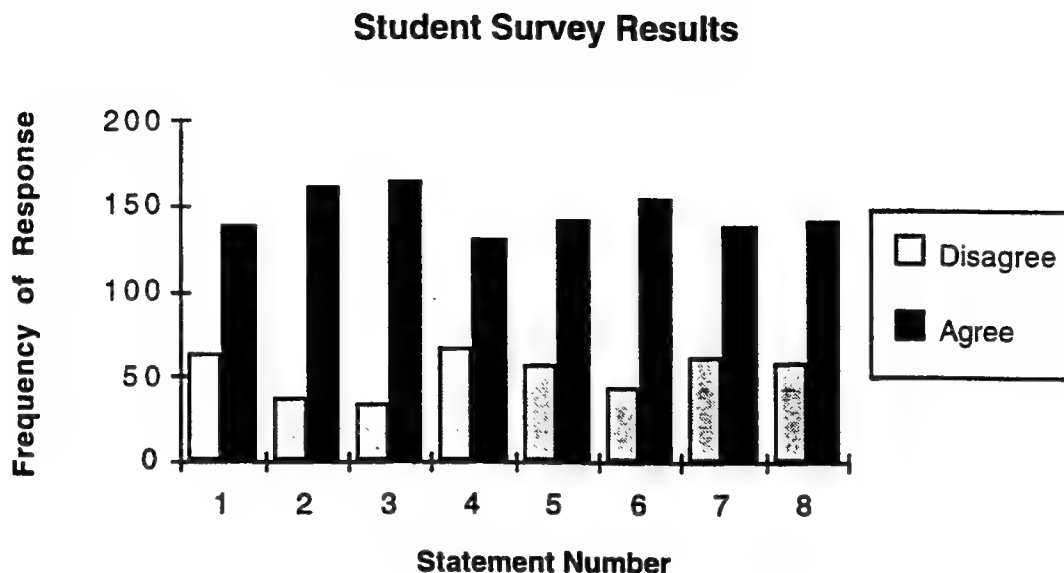
The teachers found that the weekly reports generated by the tutor were helpful at defining the number of problems completed by the students and identifying those students who were having particular difficulty. The teachers found that the students still wanted the personal contact with the teacher and enjoyed informing the teacher when they had completed a problem. The log book entries of the students not only showed the level of frustration or accomplishment felt by the students, it also allowed the teachers to become more personally aware of their students. This aided in their personal interactions and understanding of their students as people. Many of the teachers reported becoming a member of a team with the students as they struggled through solving the problems together.

The teachers generally felt that the project would be more effective and more easily integrated into the classroom if lab time was adjusted based on material covered in the classroom. As a topic is covered in class, a few days could be spent in the lab doing problems associated with that topic. Then the students could wait until the next topic is introduced before returning to the lab. The teachers felt that this type of flexibility in scheduling would allow for a greater coherency between classroom and lab activities.

The student questionnaire results indicate that, in general, the students had a positive impression of the tutor (see Figure 2). This was the teachers' impression as well. The actual effectiveness of the tutor at improving test scores will not be evident until the testing data is released from Armstrong Lab. However, if enthusiasm and

desire to continue to use the software is a judge, then the FST project can be considered a success.

Figure 2 -



Statements:

1. I feel that this program will help (or has helped) increase my score on the Ohio Proficiency Test.
2. I feel that this program is helping me master word problems.
3. I feel that exposure to word problems is a good thing.
4. My attendance is better on computer lab days.
5. I pay more attention in class on computer lab days.
6. This project has increased my enthusiasm for learning.
7. This project has increased my enthusiasm for math class.
8. This project has increased my enthusiasm for solving word problems.

APPENDICES

Appendix A: FST Word Problem Solving Teacher Questionnaire with Results

Appendix B: FST Word Problem Solving Student Questionnaire

Appendix C: FST Word Problem Solving Student Questionnaire Raw Data

Appendix D: Meeting Minutes from Final Teachers Meeting

Appendix E: Excerpts from Student Logs

Appendix F: Examples of Student Reports

Appendix G: Example of a Tutorial Available with the Latest Version of the Tutor

Appendix A:

FST Word Problem Solving Teacher Questionnaire

Please answer each of the following questions as completely as possible. Use additional paper if needed. This information will help our local team assess the effectiveness of this project. Your name and school will be confidential. Please feel free to say exactly how you feel.

Assign the appropriate number to each statement below according to how strongly you agree with that statement.

1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

_____ 1. I feel that this project has had a positive impact on my students. (Why or why not?) (If yes, then in what ways?)

Teacher 1: 4 *The students were enthusiastic about lab visits and are more willing to attempt to solve word problems.*

Teacher 2: 3 *Most of the students seem to enjoy going to the lab.*

Teacher 3: – *The majority of the students felt a sense of accomplishment even when they only solved one or two word problems. They liked the non traditional presentation of the word problems. Even though they did not complete many problems outside of the tutor, the students were able to follow the problem solving steps. When the students were given word problems in the book they at least attempted to work them.*

Teacher 4: 2 *As a rule, the students taking this class would be labeled non-conformists. The process of solving word problems embraced by FST required conformity. Thereby the majority of my students never embraced the lab experience as positive. The problems' relevance in their lives were minuscule. They look upon regimentation disdainfully and that's how some perceived the lab.*

Teacher 5: 3 *Students looked forward to going to the computer lab even though the type of work would have been skipped in the classroom. Students were more confident in approaching word problems.*

Teacher 6: 4 *Some students have not had constant experiences on the computer. Many students had not used a computer as a tool for learning. This tutor was also very different from previous tutors students had experienced. Students were able to do many word problems that they would usually not do. Many students had a feeling of accomplishment at the end of this year. They were frustrated at the first, but in the end they were really enjoying themselves.*

_____ 2. I feel that this project has had a positive impact on my teaching abilities. (Why or why not?)

Teacher 1: 3 *This project has had a most positive impact on my teaching technique because through this project I have become computer aware and able to focus on my students' individual problem solving needs.*

Teacher 2: 3 *Going into the project was quite a challenge to me but the more we went to the lab, I began to feel a little more comfortable.*

Teacher 3: – *My ability to adapt to change was challenged and strengthened. I tried to use different cooperative learning activities in class since nontraditional seems to motivate the students. I used calculators when I wanted to stress the procedure and not the solution.*

Teacher 4: 3 *I foresee this project as being a welcomed tool for those students who are self-motivated. They are the classes which made this project a positive experience.*

Teacher 5: 3 *The project curriculum re-enforced concepts which I covered in class in a manner the students enjoyed. I also became more comfortable with using computers in the classroom. At times I felt frustrated in not being able to get around to all the students needing help.*

Teacher 6: 4 *If there is just one thing I learned this year it is that computers can be a useful tool in helping struggling students begin to think and use problem solving techniques. I had more opportunities to work one on one with many students while other students worked ahead. My time in the lab was spent helping students and learning.*

_____ 3. I am satisfied with the way this project was organized.
(Why or why not?)

Teacher 1: – *Too new for me to measure.*

Teacher 2: 3

Teacher 3: – *The organization of the project was good: Teacher able to instruct, coordinator to do paper work and contact, and the technician taking care of the mechanics. The many changes the teachers had to adjust to were challenging enough.*

Teacher 4: 3

Teacher 5: 3 *Technician was very helpful when there was a problem. Curriculum pretty well followed what I was doing in the classroom. Look forward to the new additions to the curriculum.*

Teacher 6: 4 *The meeting and communication was professional and well organized. All my needs were met.*

Answer the following questions as accurately and as thoroughly as possible.

4. What part of the software do you feel works the best? (Why?)

Teacher 1: *The software calculated the problem solutions. Thus, the students were not discouraged with computations and could concentrate more on problem solving strategies. Also the notebook entries enabled the students to feel a personal involvement with the program. The ability of the teacher to select the software topics to correlate with one's teaching concept.*

Teacher 2: *The whole numbers*

Teacher 3: *The menu for problem solving strategies was great because when the students used it if they did one step incorrectly the software would not allow them to answer the question. Also, the ability of the program to perform calculations after the equation was written because it made the students concentrate on problem solving and their success was not dependent on calculation errors. In the last weeks in this version of the software it was good for each teacher to choose individual topics and levels for students.*

Teacher 4: *Tutorial introductions reminds the student or reinforces what the teacher taught.*

Teacher 5: *Having the students go through the 5-step approach to problem solving. This technique may be applied to all types of problem solving in other areas of study.*

Teacher 6: *The lesson preview was helpful because I was able to use it as a teaching tool and the students were able to use it as a learning tool. The students could go there for help anytime during the lesson which allowed them to use more of the computer for help and less of me.*

5. How has the information available from the tutor influenced your teaching?

Teacher 1: *The weekly reports of the students' number of problems worked enabled me to more readily concentrate on my student problem solving progress and needs once we were in the classroom.*

Teacher 2: *Students can work with the computers*

Teacher 3: *I tried to incorporate more reading in the class. Each student was given more positive reinforcement (exaggerated). Also I tried many many different materials in class. In solving equations I tried to consider the steps and emphasized the procedure more than the answer.*

Teacher 4: *The immediate feedback of students completion of x number problems made me aware that the grasp of the concepts by the class needed to be reinforced in the classroom. I also became more aware of doing every step and skipping none when demonstrating problems in the classroom.*

Teacher 5: *More concentration on application of concepts rather than drill. Less lecturing more guidance.*

Teacher 6: *As stated in #2, the computers are a good source for learning, if used properly. I will try to use more computer programs to supplement my curriculum more*

often next year. It allows me to work one on one with slower students while giving the other students the opportunity to work ahead. The slower students are not rushed and the others are not bored.

6. How has the information available from the tutor influenced your interaction with individual students?

Teacher 1: *The notebook entry reports helped me to personally understand more about my students concerning their attitudes and individual feelings.*

Teacher 2: *We became a team. We learned different methods together.*

Teacher 3: *I could see an increase in the tolerance level of students in individual work without help from the teacher. The overall amount of problems did not always mean the students needed more help and I tried to be more patient and used more small groups. If many of the students needed help on one particular problem, I would explain it in the lab or the next day in class.*

Teacher 4: *It enabled me to immediately see where the student was having difficulty. As the level of problems rose, so did frustration, initially. As months progressed in lab the necessity for me to work with students individually diminished.*

Teacher 5: *Provided an opportunity to work with individual students more and able to determine areas of weakness.*

Teacher 6: *I was able to give students more individual attention. Students were not ashamed to ask for help because others around them do not know what they are having trouble completing.*

7. If you had a choice, how would you organize class time in and out of the computer room? (Why?)

Teacher 1: *Ideally, I would use the lab as a reinforcement supplement to be used after I have introduced a concept versus a strict schedule of visiting the lab the same day each week as we did this year. Too much time was spent in the lab explaining concepts which should have been handled with classroom instruction.*

Teacher 2: *The organization was OK, but too much emphasis and pressure was placed upon me personally concerning the paper work.*

Teacher 3: *I would prefer to use the lab after teaching a topic so it would be more relevant to the students. It was difficult to keep a continuous connection between class and lab. Sometimes we needed two consecutive days in the lab so that all students would benefit from the problems worked.*

Teacher 4: *Rather than scheduling time weekly, it would be according to topic completion. When the topic is first to be taught: Ex: Algebraic Eq., it would be weekly. Once it was completed and the students tested, I would have liked to spend 2 or 3 days in a row in lab for them to complete all the lab problems on this area. Then perhaps 1 or 2 problems for review as a new area is begun.*

Teacher 5: *Have the freedom to go in at the time concepts were covered in class; integration of concepts in the lab and the classroom.*

Teacher 6: *I would have to be able to reinforce my curriculum with computer lab time. It was of course hard to do this in the beginning but toward the end of the year the computer problems were more related. I would use the computers to introduce a concept, to review a concept, and to develop a concept. Through problem solving skills and exploration I hope to expose students to computers in every class.*

8. Do you have any comments or suggestions for improvements?

Teacher 1: *(1) At the initial stage of the program, more lab assistants are necessary and may be decreased, later, depending on the progress and size of the class. Initially, the students need hands on and individual attention. (2) The availability of more flexibility in scheduling students to the lab would allow for better correlation of classroom and lab topics. (3) More feedback and follow-up information about our reports sent to Texas would be beneficial.*

Teacher 2:

Teacher 3: *I do not feel the project committee listened to the concerns of the educators. The changes made in the software in the last 6 weeks should have been given to our site earlier. The students showed great improvement in attitude and the ability to solve problems without assistance. I hope the concerns of the educators are considered with more respect. There is a need to explore different methods, hypotheses and narration. But the participants are students. Their needs should be the top priority. There should be a practice lesson for the teacher to use at the beginning of the year. The teachers should have access to the software weeks before the use by students.*

Teacher 4: *(1) Hint section: perhaps the students might be more willing to get help from the FST if the help was personalized. Ex: 'John! Did you put the correct units with your answer?' (2) Non-motivated students might try harder if there were a reward after each level was completed: 30 second Tic Tac Toe against the computer, etc. (3) Quiz printout or results of quiz printout per topic.*

Teacher 5: *In some of the curriculum I felt there were too many problems exactly alike(Algebraic Equations Level 1). At times the hints were of no value. Smaller groups when working with the lower level of pre-algebra students. Possibly training upperclassmen to work as aides.*

Teacher 6: *You may want to look into bring people from San Antonio to work with the teachers prior to the start date of student use. Maybe around early September. Some of the teachers are not computer literate and they may feel uncomfortable about using the computer. More one on one time may be needed.*

Appendix B:**FST Word Problem Solving Student Questionnaire**

Teacher: _____

Period: _____

Assign the appropriate number to each statement below according to how strongly you agree with that statement.

1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

- _____ 1. I feel that this program will help (or has helped) increase my score on the Ohio Proficiency Test.
- _____ 2. I feel that this program is helping me master word problems.
- _____ 3. I feel that exposure to word problems is a good thing.
- _____ 4. My attendance is better on computer lab days.
- _____ 5. I pay more attention in class on computer lab days.
- _____ 6. This project has increased my enthusiasm for learning.
- _____ 7. This project has increased my enthusiasm for math class.
- _____ 8. This project has increased my enthusiasm for solving word problems.

Appendix C:

FST Word Problem Solving Student Questionnaire Raw Data

Teacher	Period	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8
Boike	3	2	2	1	3	2	1	1	1
		4	3	3	1	1	3	1	3
		1	2	3	4	4	4	4	4
		4	4	4	1	3	3	4	3
		3	3	3	3	4	3	2	3
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		2	3	2	3	2	4	3	1
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		3	4	3	1	4	3	3	2
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		4	2	4	3	4	3	2	1
		1	3	3	3	3	3	4	3
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		1	1	1	1	1	1	1	1
		4	3	4	4	3	4	4	4
		4	3	3	3	4	3	3	3
		2	3	3	4	4	2	3	3
		3	2	3	3	3	3	2	3
		3	2	3	2	2	3	2	3
		3	3	4	4	4	2	2	3
		4	2	4	4	4	4	3	4
		3	3	3	2	2	3	3	3
		4	3	4	2	1	2	4	3
		4	4	4	3	4	4	4	4
		2	2	2	2	2	2	2	2
		3	3	4	3	4	4	4	3
		4	4	3	4	4	4	3	4
Bobo	6	3	3	4	1	3	3	3	2
		2	4	3	1	3	3	3	3
		1	3	3	4	4	3	3	3
		2	4	3	1	4	4	3	4
		3	3	3	3	1	4	3	4
		2	3	4	4	4	3	4	3
		3	4	4	3	3	4	4	3
		3	3	3	4	4	3	4	3

Appendix D:

Meeting Minutes from Final Teachers Meeting

Project F.A.S.T. Track Joint Teachers Meeting

May 13, 1993

3:45-5:15

Trotwood-Madison High School

Attendance:

Sue Rinehart
Nancy Baerwald
Katie Thorp
Shirley Cooper
Mike Bader
Stacy Robinson
Dorothy Boike
Kathy Hepner
Ron Rogacki
Carlyn Miller
Kay Thomas
Jacqueline Brown
Jacqueline Bobo

The meeting was called to order by Sue Rinehart at 4:00 and everyone was introduced. Sue began the meeting by asking how things were going in the lab.

Ron Rogacki said that things came quickly back to order following the strike. The most important thing which happened in the lab was that Dunbar got a new version of the software (a version which had previously been at Trotwood-Madison). The new version has seven levels of difficulty for problems in the tutor. This is much better than the three levels which were available in the previous version of the tutor. The students do not get as frustrated and this has been a 'big plus'. Both the teachers and the students like the introductory segments at the beginning of each module in the new tutor version. This might take some time away from the class, but it is a good review.

Ron got a call from a man in Yellow Springs who saw the Dayton School Board meeting on T.V. which discussed F.S.T. and praised Ron and the rest of the Dunbar teachers. The man wanted to know if Wright-Pat had any other "similar programs".

Sue Rinehart advised everyone that Armstrong Lab's position is "no expansion of FST research sites." Sue advised that in the future all inquiry calls should be routed to the Alliance office.

Nancy Baerwald suggested that Ron advise the man to call the Wright-Pat public affairs office. Ron was given the phone number.

Mike Bader said, "We have come a long way." This time last year the classroom was really trashed and now it is a very nice facility. The students have really benefited.

Stacy Robinson said that she likes the new version of the software. The students are enjoying the system a lot better than when this first began. Now they are able to work with only an occasional question. Their attitudes have changed about the lab. They are more enthusiastic about going in to the lab. Some students will even come in after school to make up a missed session in the lab. She likes that software and she hopes that they get to use it next year as well.

Kathy Hepner said that she has a new student teacher who picked up the system right away. She let the students teach her and it worked very well. Having three knowledgeable adults in the lab is very helpful. Kathy's main problem has been that she tries to help the students too much. She also has one or two students who seem to always be absent on lab days. She does not understand why.

Dorothy Boike said that her students look forward to going into the lab. Some days they are very enthusiastic. Some students were hesitant in the beginning, but now they are more enthusiastic and comfortable with the software and the computers. She had one student who said, "I don't like computers." But now he works on the system along with the others. The graphic capabilities of this new software version make it more interesting for the lower level students. She still has a few students who just will not work at all. One student often says, "Do I have to go to the lab?" And then when he is in there, he just plays with the screen and doesn't do any problems. However, he never works in class either. In class he just sits and draws. Dorothy feels that some of the problems on the tutor are too difficult for her pre-algebra students.

Jacqueline Bobo said that she has an attendance problem and typically only 10-12 students come to class, either in the lab or in normal class. Those few who do come, however, work well. She prefers the smaller class size because it makes it easier for her to help the students.

Stacy Robinson said that her morning classes tend to be more attentive than her afternoon classes in the lab, but that is also true of normal class periods as well.

Dorothy likes the system better now that they are doing the same thing in class as they are in lab.

Stacey said that it was hard to relate the lab to class at first. There were no problems in certain areas which they were covering in class. Now it is nice to find things that relate.

Ron said that if they had had the version that they have now at the beginning, it would have been good.

Stacy said that the problem solving process that they were going through in the lab was very separate from the lesson plans that they were following in class. This made it hard to teach because the lab day became like a 'field trip.' She would have to review what they had been working on in class to get back to where she was in her lecture.

Carlyn said that at first a few students did not like the labs. Now that has changed. The cluster has better attendance, so she tends to have a full class when she goes into the lab. With a packed lab you really need two people available to help the students. The students don't like to go for help in the software. When they complete a problem correctly, smiles come on their faces. They like the routine of going into the lab.

Kay Thomas 'Puts the fear into them.' The other teachers have helped her out in the lab.

Jacqueline Brown agreed with most of what the other teachers had said. The level of difficulty of the problems is better now that there are more levels to chose from. The tutor has helped the students in the regular classroom as well. The students are taking pride in their work and are "feeling success in the classroom too." A few students tend to skip on lab days. Jacqueline enjoys the new introductory section at the beginning of each new module. The first time she had each student go through it separately. This last time she had everyone go through it as a class. Will did the 'clicking' at the computer and she had one of the students read the screen aloud. This freed her up to stand up at the screen and help the class. This worked well and the students enjoyed it.

Kathy felt that there were some picky questions in the "areas" section of the tutor. The question asked some details about the units of the problem.

Jacqueline Brown disagreed. She thought that it was important that the students pay attention to details like units.

Kathy said that some of the problems in the "volumes" section were some of the hardest that she had ever seen. They asked for conversion between metric and English units which is not covered in class.

Jacqueline Brown agreed. Dunbar has not started on "volumes" yet, but it is not 'fair' to cover conversion between the two systems of measure.

Kathy suggested that Dunbar try out a few problems in the "volumes" section before they assign them to the students.

Stacy agreed, saying that the problems are very tough. She went on to say that it was particularly hard for the students at the beginning of the year when the problems through out the tutor were more difficult. Now that more levels are available, it will be nice at the beginning of next year because the students will be able to start out with a feeling of success. It would be nice to have more control over the problems which are covered so that they can directly relate to level and topic being covered in class. Otherwise the lab just becomes something to do which is unrelated to classroom activities.

Sue asked how much of the time the teachers estimate that the lab sessions were not related to what was being covered in class. The Trotwood-Madison teachers estimated it at 85-90% and the Dunbar teachers agreed on 70%. The main problem seems to be that many of the modules have been incomplete.

Technical Problems

Stacy said that there have been some problems with print-outs missing student names. There were a few log-on problems at the beginning and a few others but most of them have been solved by Will or Armstrong Lab. One problem is that the help segments sometimes ask the student to make a drawing on a piece of paper and the teachers were not allowing the students to have paper and pencil at the terminals.

Jacqueline Bobo let the students have a few pieces of paper and a pencil because they had requested it. The privilege has not been abused and she makes sure that they are carefully supervised.

Successes

Kathy said that her students get very excited when they get a problem correct. She has some students who are doing 8-12 problems a day.

Jacqueline Brown said she lets the students put their name on the board and then make a mark when they have gotten a problem correct. This creates a competitive environment which the students seem to enjoy. The students who are having more difficulty don't seem to get embarrassed.

Jacqueline Bobo said that the students still like the teacher to know that they have been successful at solving a problem. She said, "I am a success story." Things are now going very well. She has learned and grown along with the students. She feels good about things. She enjoys pulling up a chair to help students and she would have been frustrated if she had had a larger class. She has students who are putting forth a positive effort in the lab and not in the classroom, which is better than nothing at all. She considers herself to be a success story because she was very frustrated when she was in Texas. The Armstrong Lab folks assumed that the teachers knew certain things before they went and then they moved very fast. At that point she felt like she did not want to be a part of the program (Kay Thomas felt the same way). Kurt Steuck 'saved the program.' He took the time to listen. He was patient and stayed additional time to help. He gave Jacqueline a little confidence. He was very understanding and showed compassion.

Ron said that he still had to push her into the lab the first day.

Nancy said that she was in the lab the first day and she thought that both Jacqueline Bobo and Kay Thomas did an excellent job. It is hard for a teacher to admit that s/he does not know everything. The teachers were honest with the students. This worked well. Nancy was very proud of the way the teachers handled themselves.

Suggestions to Prepare the English Teachers for 1993-1194

Jacqueline Bobo said that she could be a good reference to teachers who do not know computers. She said to be sensitive to teachers who have little or no experience with computers.

Kathy suggested that the teachers at least be allowed to play with the software before they go, even the math tutor or solitaire would help.

Stacy brought up the point that at least the English teachers will be able to come right back and start practicing after Texas.

Local Assessment

Katie Thorp then passed out copies of a teacher and a student questionnaire. The teachers agreed to fill out their questionnaires, hand out copies of the student questionnaire, and return all completed forms to their site coordinator by the end of the school year.

End-of-Year Activities

Sue then made sure that everyone was prepared for the post-testing and was aware of the dates. She informed the teachers that they would be asked to fill out a Curriculum Module Usage Checklist estimating their time on each module of the tutor.

Ron said that by printing the logs from second semester they can see how many days were spent on each category. Most of the first semester was spent on "whole numbers."

Sue asked what would be the last day that the labs would be in use. The response was the 18-19th of May.

Sue passed around a copy of the certificates and asked that the teachers get the list of final names to her by Monday noon so that she can get them printed. Everyone agreed that the certificates would be sufficient and the no other special recognition was necessary for the students.

Sue then asked if the teachers want to use the labs next year and everyone agreed that they do. Sue then asked if they would want to go in even if there was not a technician in the room with them. After some discussion, everyone agreed that a technician is essential. The teachers do not want to be responsible for problems with the hardware or software. If there were a problem during a math class, that problem could then continue on into an English class scheduled to use the room next. This could then harm the research.

The meeting adjourned at about 5:20.

Respectfully submitted by
Katie Thorp, UDRI

Appendix E:

Excerpts from Student Logs

Notebook db0666.tbk

November 5. 1992

November 5. 1992

TODAY I am in Math class I don't understand the work. I am not happy today because my boyfriend is not here.

November 11. 1992

November 11. 1992

I understand it a little better than last week. My boyfriend is not here today I am upset with him. He has not ben here for three days. I think I understand it some tomorrow or next week.

November 20. 1992

I hate working on this compute it is hard to work on this problem today. I broke up with my boyfriend. he was going to breke up with me. I am a little bit upset with him.

December 2. 1992

Today has ben a great day. I done two probles on the compute today I hope tomorrow is great too. I wish christmas was here already here. I hope I have a great day all day too.

I got my answer right it is handakes
I think.
December 3. 1992

Notebook db0603.tbk

November 4. 1992

I ' think this program is very nice its better
than papper work I myself like working on computers periodI
wish the class could do this everyday.

November 20. 1992

December 9. 1992

December 9. 1992

I did one promble today.
There is not enough teachers in this computer lab.

December 16. 1992

I doing okay in math class but I hate doing the computers. I
hope to due better next week.

January 6. 1993

I had a nice break. I like the computers a little bit. they are
very hard to understand it.

January 20. 1993

Notebook db0463.tbl

November 4. 1992

November 4. 1992

November 5. 1992

November 11. 1992

I could not under stand how to do threw all the steps with out problems.

November 20. 1992

November 20. 1992

I don t like this class at all becouse it s so confusing and this girl next to me keeps on laughing.

December 2. 1992

This day in the computer lab was quit boring and complicated I solved my first problem and could not solve my second one....

December 5. 1992

I came close to getting a problem right but i just get it
completly finished but I ll get it next time.

December 9. 1992

I ve solved a nother problem today and it's so cool! uottie

like who.

December 16. 1992

today i got another problem done and working on the next one..

January 6. 1993

January 20. 1993

Notebook db0582.tbi

November 4. 1992

The one thing that i learned in
this class is that you got to have
alot of patice.

November 5. 1992

November 11. 1992

What it is that ive been havind
trouble with is that i cant remember
everythind that we soppose to do.

Nov.11.1992

December 2. 1992

December 2. 1992

Finally i solved a problem.
It was hard but i did it. It was
kind of fun . kind of

c ya

MS.Sidneta Wafer

December 9. 1992

today : done four problems

i guess im geting better at this.
im starting a new one now.

cya and wouldnt
want to be ya !!!!!!!!!!!

December 16. 1992

Today i did three problems.

they was kinda easy i had a
little help. But other wise i did
it all by my self. I think this is
a good way to learn math at least for me cause the rest of the
stuff is
kinda hard for me cause i learn
slower than others.

OUTTY OUTTY

Whats up

!!

January 5. 1993

January 20. 1993

Appendix F:

Examples of Student Reports

studentName #hp #er	id#	date	# type	lev	time	#st
0 0	DB0071	11/4/92	153-whole	1	1521	12
18 16		11/20/92	155 whole	1	6386	145
3 3		00/00/00	158 whole	1	574	16
0 0		11/20/92	168 whole	2	incomplete	17
2 1		12/2/92	131-whole	1	460	14
22 13		12/2/92	134 whole	1	1703	60
4 4		12/2/92	141 whole	1	492	20
4 3		12/3/92	156 whole	2	1821	47
4 2		00/00/00	163 whole	2	497	24
11 10		12/16/92	153 -whole	1	incomplete	63
2 1		12/16/92	153 -whole	1	377	19
2 5		12/16/92	155 -whole	1	865	29
8 7		12/16/92	158 whole	1	1403	26
2 2		12/16/92	159 whole	1	incomplete	45
7 2		1/6/93	126 whole	1	1444	33
2 4		1/6/93	131-whole	1	1178	28
0 1		1/6/93	134 whole	1	incomplete	47

studentName #hp #er	id#	date	#	type	lev	time	#st
	DB0092	11/11/92	4	whole	1	3306	83
15 16		00/00/00	5	whole	1	717	18
4 6		11/11/92	22	whole	1	256	14
1 1		11/20/92	145	whole	2	incomplete	51
2 0		12/16/92	5	whole	1	2902	99
14 20		00/00/00	22	whole	1	257	9
1 1		12/16/92	48	whole	1	1116	39
8 11		12/16/92	94	whole	2	483	10
0 0		00/00/00	99	whole	2	293	12
0 0		12/16/92	67	whole	1	incomplete	33
0 0		1/6/93	103	whole	1	341	15
1 1		1/6/93	126	whole	1	1136	20
1 1		1/6/93	131	whole	1	961	32
10 8		00/00/00	156	whole	2	incomplete	43
2 0							

studentName #hp #er	id#	date	#	type	lev	time	#st
3 0	DB0050	10/27/92	504	rates	1	2004	40
10 2		00/00/00	507	rates	1	763	20
0 0		10/28/92	123	rates	1	3241	9
0 0		00/00/00	115	rates	2	1922	9
0 0		10/29/92	546	rates	2	incomplete	22
2 0		11/4/92	141	whole	1	4408	76
2 2		11/4/92	153	whole	1	1654	139
0 0		11/5/92	155	whole	1	incomplete	69
0 0		00/00/00	163	whole	2	incomplete	0
0 0		11/5/92	168	whole	2	incomplete	0
0 0		11/5/92	133	decim	1	incomplete	0
0 0		11/5/92	181	decim	1	789	17
2 0		11/11/92	50	decim	1	1353	11
1 0		11/19/92	166	decim	2	4143	45
8 5		12/1/92	30	decim	2	incomplete	6
0 0		12/17/92	48	whole	1	incomplete	0
0 0							

Appendix G:**Example of a Tutorial Available with the Latest Version of the Tutor**

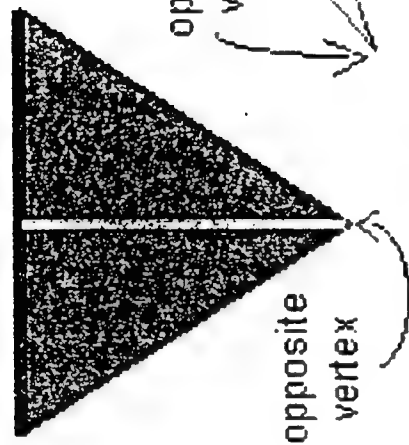
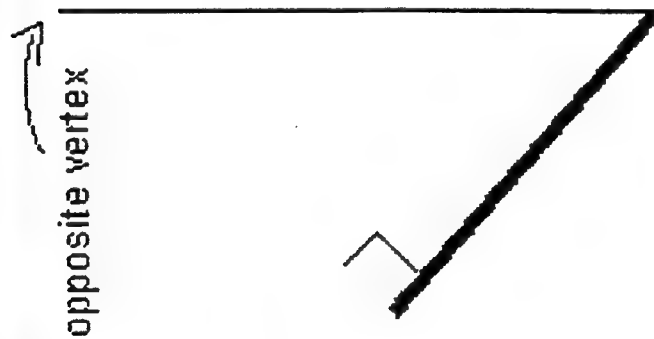
AREA OF TRIANGLES

Area of Triangles

Version 1.04 By: Carolyn Pesthy Murceil Wisakowsky
Keith Brown V. Larralde

Next

AREA OF TRIANGLES



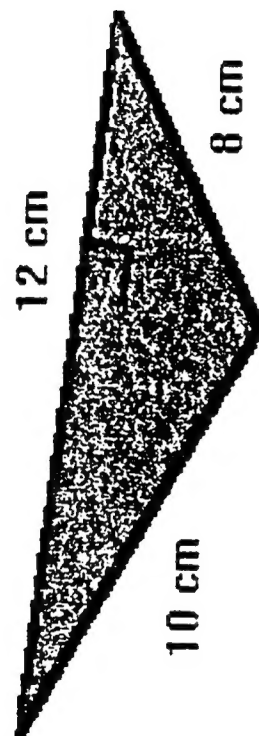
opposite
vertex

KEY: height
base

Any side of the triangle may serve as the base. The height is the distance from the base to the vertex opposite the base. Notice that the height is perpendicular to the line containing the base.

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Next



Given the above figure, what value would you use for b in the formula $A = \frac{1}{2}bh$.

- a. 12 cm
- b. 8 cm
- c. 10 cm

Back

Next

Nice job! But before we have fun with more problems, remember:

- ▲ Right triangle: a triangle with one right angle = 90°
- ▲ Acute triangle: a triangle with 3 angles all less than 90°
- ▲ Obtuse triangle: a triangle with 1 angle greater than 90°
- ▲ Equilateral triangle: all 3 sides are equal length
- ▲ Isosceles triangle: 2 sides are equal length
- ▲ Scalene triangle: no two sides are equal

▲ The formula for the area of a triangle is: $A = \frac{1}{2}bh$

b is the base

h is the height

▲ The units used for area of a triangle should be square units.

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VARRALDE'S Math Tutor Book

File Problem Solving Steps Tools Help

Problem Window

254- Philippine Flag: In 1935, the flag pictured on the screen was designated as the national flag of the Philippine Islands. Notice the large white triangle. Its base is 30 inches and its height is 25 inches. What is the area (in square inches) of the white triangle? (See picture under TOOLS menu item)

Variables Window

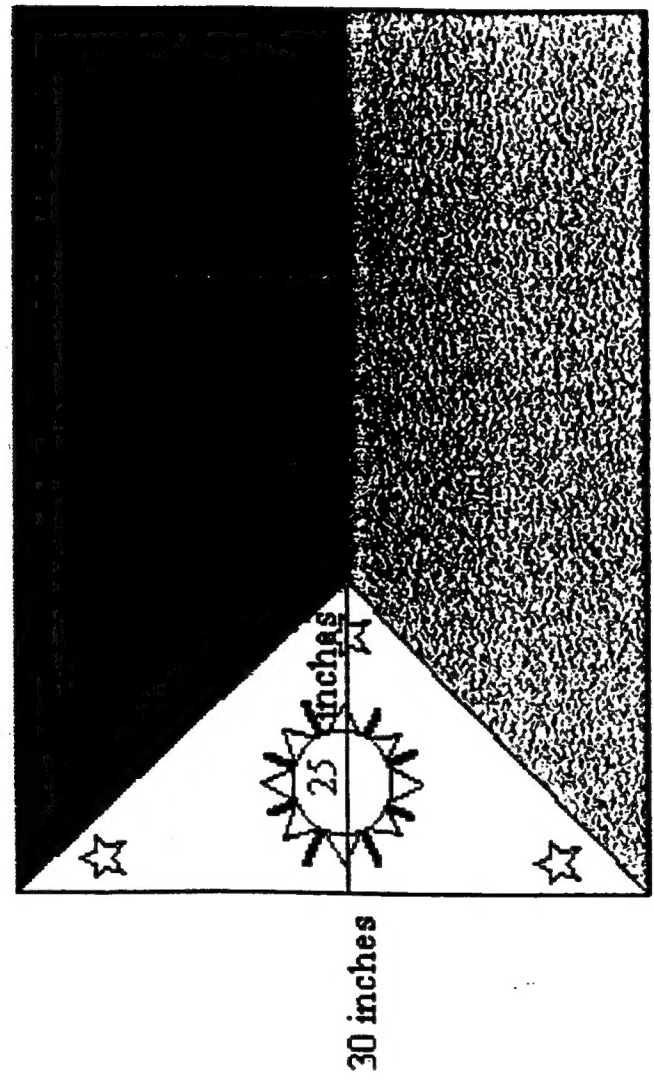
{ } +
)
 *
 /
 =

Equation Window

Instruction Advice Window

Drag here with mouse to move

Philippine Islands



Hide Picture